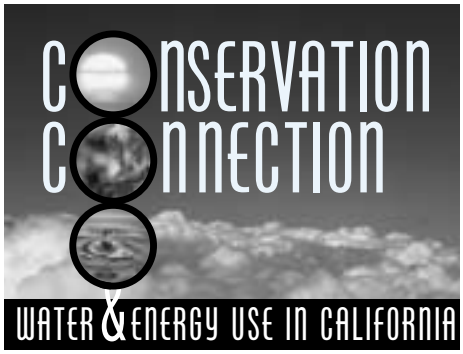


A CURRICULUM
ANALYZING WATER & ENERGY USE
AT HOME AND AT SCHOOL

PRODUCED BY:

Central Basin
Municipal Water District

and

West Basin
Municipal Water District

through a grant from
The State of California Department of Water Resources
2004

CURRICULUM DEVELOPMENT BY:
Educational Development Specialists

GRAPHICS BY: Design Perspective

ILLUSTRATION BY: Olimb Graphics

We turn on the tap and water flows out. We turn on a lamp and light fills the room. We depend on water and energy. We need water and energy to live in this world. But where do we get the water and energy that we use? And will we always have enough to meet our needs?

Conservation Connection answers those questions, showing the connections between California, our water and energy supply, and us. But providing information is only part of *Conservation Connection*. The goal of the curriculum is to get students actively involved—in their homes and at school—in conserving water and energy.

Within the program, students have the opportunity to:

- survey their families' water and energy use
- survey water and energy use at their school.

After gathering data, analyzing their findings, and reviewing recommendations, students make, implement, and monitor plans to decrease water and energy use. By participating in this action-based curriculum, students will learn to look critically at important environmental issues and take responsibility for finding solutions.

Learning Objectives

1. Identify basic facts about the sources supplying water in California—surface water and groundwater.

2. Identify the various uses of water throughout California in the agricultural, environmental, and urban sectors.

3. Identify the problems of water supply meeting water demand, including:
   - money
   - the environment
   - population

4. Identify ways of stretching our water supply, including:
   - recycling
   - desalination
   - new water-efficient technologies
   - conservation practices

5. Identify basic facts about the sources supplying energy in California, including:
   - fossil fuels
   - hydropower
   - nuclear power
   - biomass
   - geothermal
   - wind
   - solar

6. Identify the various uses of energy throughout California in the transportation, industry, business, and residential sectors.

7. Identify the problems of energy supply meeting energy demand, including:
   - supply
   - the environment
   - money
   - population

8. Identify ways of supplying energy in the future, including:
   - new energy-efficient technologies
   - renewable sources
   - fuel cells
   - conservation practices

9. Assess water and energy usage by surveying:
   - personal habits
   - home use and efficiency
   - school use and efficiency

10. Identify, plan, and implement measures to save water and energy at home and at school.

Lesson Format

Each lesson is formatted as follows:

Lesson Overview: Briefly summarizes the activities that students will be doing.

Vocabulary: Lists words that are important and that may be unfamiliar to students.

Materials and Preparation: Specifies the materials needed in the lesson (e.g., worksheets, demonstration equipment) and describes what needs to be done prior to teaching the lesson (e.g., copy worksheet, set up demonstration).

Approximate Time Requirement: Gives the estimated amount of time needed to conduct all of the activities within the lesson.

Procedures: Provides detailed steps for conducting the activities, including discussion questions and suggested answers.

Extensions: Suggests other activities to extend the learning, including conducting experiments, providing more practice, addressing other content standards, and expanding the concepts into the community.

Materials

The following materials are included to teach the lessons:

- Teacher Guide
- Student Booklet (16 pages)
- Transparency Masters
  - *How Much Water Does It Use?*
  - *How Much Energy Does It Use?*
- Worksheet Masters
  - *Personal Water & Energy Use* (2 pages)
  - *Energy Source Comparison*
  - *Summary of Ways to Save Water & Energy at Home* (2 pages)
  - *Personal Water & Energy Conservation Plan*
  - *Family Water & Energy Conservation Plan*
  - *School Water & Energy Conservation Plan*
  - *Assessment* (2 pages)
- Survey Masters
  - *Home Water & Energy Survey* (4 pages)
  - *School Water & Energy Survey* (4 pages)
- Recommendation Masters
  - *Ways to Save Water & Energy at Home* (5 pages)
  - *Ways to Save Water & Energy at School* (5 pages)

Any other materials needed to conduct demonstrations or other activities in the lessons are common items, for example, poster paper, water, gallon containers. All necessary materials and preparation are listed at the beginning of each lesson.

Instructional Strategies

Each section in the student booklet begins with **Think About It...** questions, in which students are challenged to explore the answers before they are presented with the information in **Learn About It....**

The *Home Water & Energy Survey* is assigned in Lesson 1, giving students time with their families to complete it by Lesson 6 when the surveys are analyzed, as well as getting students personally involved in their use of water and energy while they are learning about the topic. The *School Water and Energy Survey,* which is presented in Lesson 7, can also be conducted while students are learning about the supply and demand of water and energy in California. The school survey or a community survey could also be used as a culminating activity.

Correlations

The activities within these lessons can be used to support many of the California State Content Standards. A chart in the appendix shows lesson correlations with standards in Science, Language Arts, and Math for grades 6 through 8.

Assessment

A cognitive assessment of the objectives listed previously is included in the appendix. If students read, discuss, and practice the information contained in the student booklet, the test can be used to assess their comprehension.

Portfolios containing students' worksheets, surveys, and conservation plans can also be used to assess students, especially in relation to implementing and monitoring their plans. Portfolios can become an integral aspect of the instructional process. And if less focus is placed on the cognitive information and more on the applied learning, the portfolio assessment would be most appropriate.

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

CONTENTS

CONTENTS

LESSON 1: WATER, ENERGY, & YOU

Lesson Overview

Students will:

- be introduced to the importance of water and energy and compare their use to use in the past
- keep track of personal water and energy use
- begin the *Home Water & Energy Survey*

Vocabulary

- condensation
- evaporation
- nonrenewable
- precipitation
- renewable
- transpiration

Materials and Preparation

- *Conservation Connection* student booklets
- *Personal Water & Energy Use* worksheet (2 pages)
  - copy for each student (back-to-back, if possible)
- *Home Water & Energy Survey* (4 pages)
  - copy for each student (as a 4-page foldover on ledger-size paper, if possible)

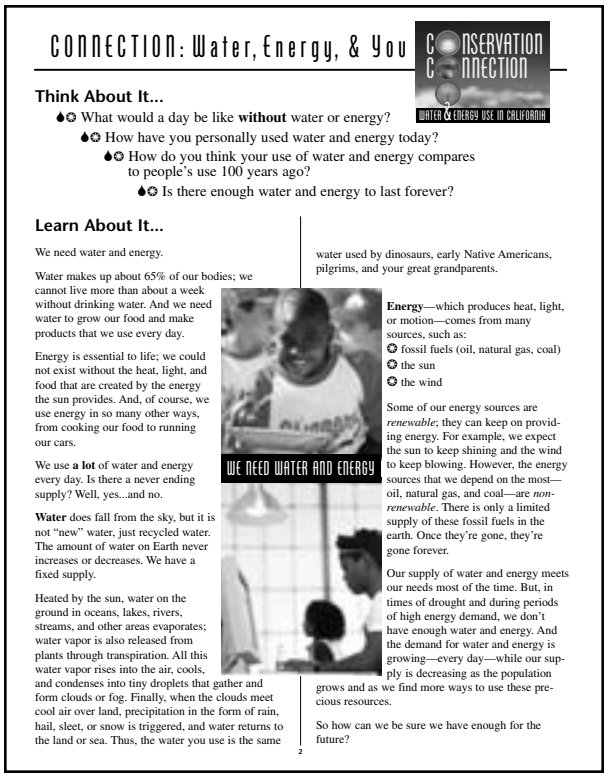
Approximate Time Requirement

- 1 class period

Procedures

I. Introduce the program

A. Distribute a copy of the **student booklet**, *Conservation Connection*, to each student and explain that the class is going to be learning about the use of water and energy, especially in California. Allow students a few moments to look through the book.



CONNECTION: Water, Energy, & You

Think About It...

- What would a day be like **without** water or energy?
- How have you personally used water and energy today?
- How do you think your use of water and energy compares to people's use 100 years ago?
- Is there enough water and energy to last forever?

Learn About It...

We need water and energy.

Water makes up about 65% of our bodies; we cannot live more than about a week without drinking water. And we need water to grow our food and make products that we use every day.

Energy is essential to life; we could not exist without the heat, light, and food that are created by the energy the sun provides. And, of course, we use energy in so many other ways, from cooking our food to running our cars.

We use **a lot** of water and energy every day. Is there a never ending supply? Well, yes...and no.

Water does fall from the sky, but it is not "new" water, just recycled water. The amount of water on Earth never increases or decreases. We have a fixed supply.

Heated by the sun, water on the ground in oceans, lakes, rivers, streams, and other areas evaporates; water vapor is also released from plants through transpiration. All this water vapor rises into the air, cools, and condenses into tiny droplets that gather and form clouds or fog. Finally, when the clouds meet cool air over land, precipitation in the form of rain, hail, sleet, or snow is triggered, and water returns to the land or sea. Thus, the water you use is the same water used by dinosaurs, early Native Americans, pilgrims, and your great grandparents.

WE NEED WATER AND ENERGY

Energy—which produces heat, light, or motion—comes from many sources, such as:

- fossil fuels (oil, natural gas, coal)
- the sun
- the wind

Some of our energy sources are *renewable*; they can keep on providing energy. For example, we expect the sun to keep shining and the wind to keep blowing. However, the energy sources that we depend on the most—oil, natural gas, and coal—are *nonrenewable*. There is only a limited supply of these fossil fuels in the earth. Once they're gone, they're gone forever.

Our supply of water and energy meets our needs most of the time. But, in times of drought and during periods of high energy demand, we don't have enough water and energy. And the demand for water and energy is growing—every day—while our supply is decreasing as the population grows and as we find more ways to use these precious resources.

So how can we be sure we have enough for the future?

2

B. Ask students to turn to page 2. Read aloud and have students discuss the questions under **Think About It....** In the discussion of each question, allow students to share their ideas, but be sure to point out the following:

1. **What would a day be like without water or energy?**
   There would be no day as we know it without water and energy; we need the radiant heat and light from the sun; we need water to drink. Without water and energy, we could not live.
2. **How have you personally used water and energy today?**
   Some personal uses may not be so obvious, such as reading clocks, drinking milk that was kept cold in the refrigerator, talking on the phone, and flushing toilets.
3. **How do you think your use of water and energy compares to people's use 100 years ago?**
   A hundred years ago, people did not have such easy access to water and energy, and they did not have so many products that use water and energy. Edison did not invent the light bulb until 1879, and the first electric power station wasn't built until 1882; the electric vacuum cleaner and washing machine were invented in 1907; the Model T automobile was put into production in 1913; only about 60% of farms had flowing indoor water by 1936.)
4. **Is there enough water and energy to last forever?**
   We do expect the sun to continue to shine and rain to continue to fall; thus, we expect there to always be water and energy. However, will we always have enough clean water and enough energy when and where it is needed for everyone?

C. Have students work in groups to list all the uses they can think of for water and for energy. Remind students that water and energy are used in places other than in the home, for example, to fight fires, grow food, manufacture paper. Ask each group to read their lists—water use and energy use. Point out that along with their direct uses, they are responsible for many "indirect" uses of water and energy in industry and agriculture.

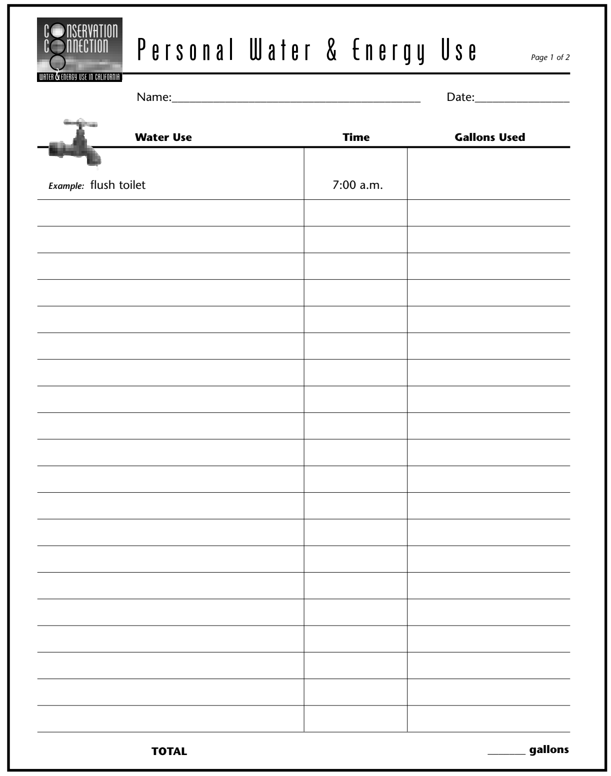
II. Learn About Water, Energy, & You

A. Have students read the text under **Learn About It...** on page 2. Then use the questions below to briefly discuss what they read. **Alternatively**, write the questions on the chalkboard, divide students into groups, and have each group answer the questions using the information on page 2 in their booklets.

1. **What is the water cycle?**
   Water circulates constantly. Water that evaporates from the ground or that is released from plants through transpiration rises into the air as water vapor. In the air, it cools and condenses and eventually falls to the earth as precipitation (rain, snow, sleet, hail), where it again evaporates and rises into the air.
2. **Can we increase our supply of water?**
   No. We have a fixed supply of water. Varying amounts of water are available in different places and at different times depending on geography and weather, but only a limited amount of water exists on Earth.
3. **How can you tell when energy is being used?**
   Energy is being used any time there is heat, light, or motion.
4. **What's the difference between *renewable* and *nonrenewable* energy sources?**
   Renewable energy sources never get used up; they are constantly resupplied by natural processes. For example, sun, wind, wood, and water are all renewable energy sources. Nonrenewable sources have only a limited amount. For example, once we've used up all the fossil fuels (oil, natural gas, coal), there will never be any more.
5. **Why do we need to be concerned about our supply of water and energy?**
   As our population grows and as we find more and more ways to use energy and water, we are using more water and energy all the time. In times of drought, our supply of water is sometimes not enough for everyone. And during periods of high energy demand, such as on hot summer days, we sometimes can't produce enough energy.

III. Track Personal Water and Energy Use

A. Give each student a copy of the worksheet ***Personal Water & Energy Use***. Explain that for 24 hours (starting either now or tomorrow morning), they are to keep track of every time they personally use water and energy. Review the examples.


Conservation Connection
Water & Energy Use in California

Personal Water & Energy Use

Page 1 of 2

Name:________________ Date:__________

Water Use	Time	Gallons Used
Example: flush toilet	7:00 a.m.	

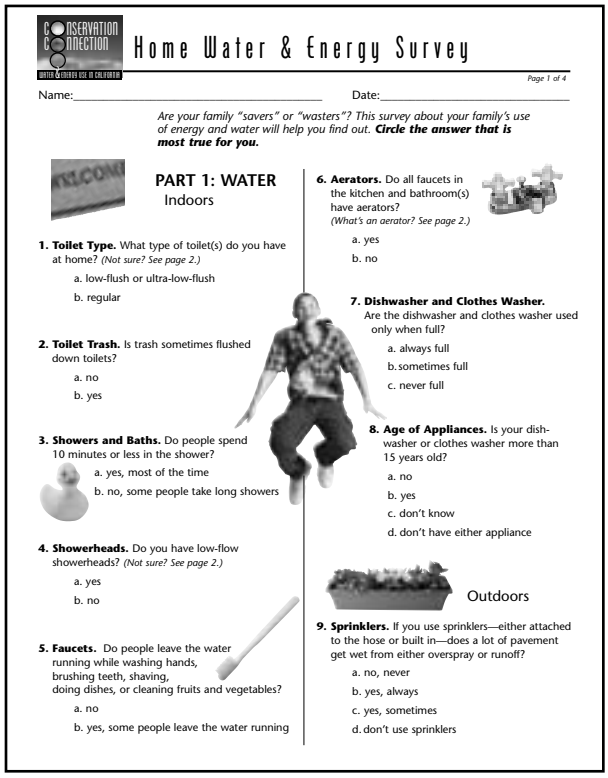
TOTAL ______ gallons

B. Point out that they are to fill in the first two columns indicating what they used and at what time. Explain that the last column—"Gallons Used" (for water) and "Kilowatt Hours or BTU Used" (for energy)—will be completed later (in Lessons 3 and 5).

IV. Introduce the Home Water & Energy Survey

A. Ask students if they think any water or energy is wasted in their homes.

B. Distribute a ***Home Water & Energy Survey*** to each student. Read aloud the information at the top of the survey.



CONSERVATION CONNECTION

Home Water & Energy Survey

Page 1 of 4

Name:_____ Date:_____

Are your family "savers" or "wasters"? This survey about your family's use of energy and water will help you find out. ***Circle the answer that is most true for you.***

PART 1: WATER
Indoors

1. Toilet Type. What type of toilet(s) do you have at home? *(Not sure? See page 2.)*
a. low-flush or ultra-low-flush
b. regular

2. Toilet Trash. Is trash sometimes flushed down toilets?
a. no
b. yes

3. Showers and Baths. Do people spend 10 minutes or less in the shower?
a. yes, most of the time
b. no, some people take long showers

4. Showerheads. Do you have low-flow showerheads? *(Not sure? See page 2.)*
a. yes
b. no

5. Faucets. Do people leave the water running while washing hands, brushing teeth, shaving, doing dishes, or cleaning fruits and vegetables?
a. no
b. yes, some people leave the water running

6. Aerators. Do all faucets in the kitchen and bathroom(s) have aerators? *(What's an aerator? See page 2.)*
a. yes
b. no

7. Dishwasher and Clothes Washer. Are the dishwasher and clothes washer used only when full?
a. always full
b. sometimes full
c. never full

8. Age of Appliances. Is your dishwasher or clothes washer more than 15 years old?
a. no
b. yes
c. don't know
d. don't have either appliance

Outdoors

9. Sprinklers. If you use sprinklers—either attached to the hose or built in—does a lot of pavement get wet from either overspray or runoff?
a. no, never
b. yes, always
c. yes, sometimes
d. don't use sprinklers

C. Tell students that they should work with their families to answer the questions on the survey. Explain that some of the items are easy to answer, but some will take investigation. Point out that tips for some of the items appear at the end of each section on pages 2 and 4.

D. Explain that they will analyze their answers to this survey to see how their families are using water and energy and where they can conserve.

E. Set a date for the surveys to be completed and returned (Lesson 6).

Extension Activities

- **Prepare water and energy timelines.** Research significant dates in our history of water *(e.g., in 1888 Thomas Crapper perfected the valve system of the toilet; in 1913 the Los Angeles Aqueduct began delivering water; in 1914 the first drinking water standards were adopted)* and energy *(e.g., in 1879 Thomas Edison invented the light bulb; in 1903 the Wright Brothers flew the first airplane; in 1942 the first nuclear chain reaction was demonstrated)* and make murals depicting the events throughout history.
- **Compare water and energy use throughout history**. Divide students into groups and assign each group to research a particular historical group of people—such as the first colonists, early Native Americans, settlers on the frontier, plantation owners during the Civil War, etc.—to determine their water and energy sources and uses.
- **Investigate droughts in California.** What defines a drought? When was the last one in California? What's the history of droughts in California? How long do they last? What effects do they have on people, on the environment, on the economy?

LESSON 2: WATER SUPPLY & DEMAND

Lesson Overview

Students will:

- learn about surface water and groundwater
- determine how water is used in California (agriculture, environment, urban)
- discuss the problem of water supply meeting water demand

Vocabulary

- aqueduct
- aquifer
- groundwater
- overdraft
- reservoir
- surface water

Materials and Preparation

- *Conservation Connection* student booklets
- Topographical wall map of California

Approximate Time Requirement

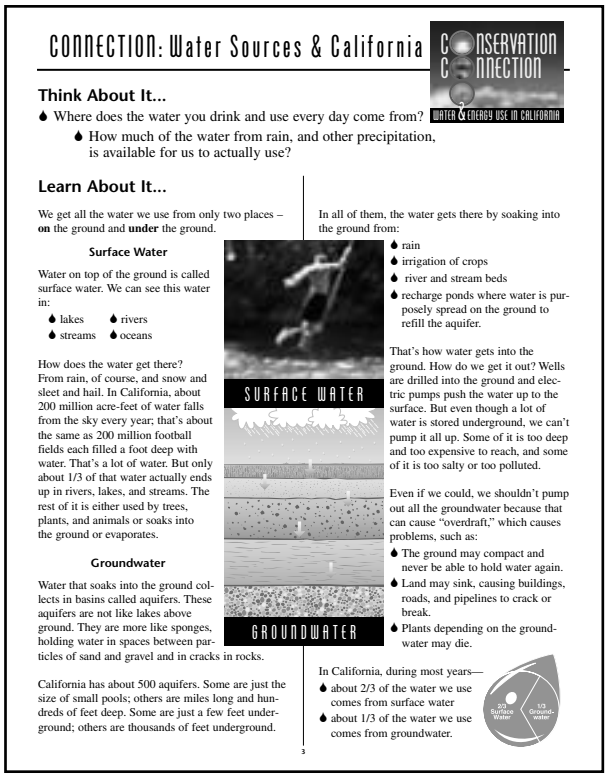
- 1 class period

Procedures

I. Think About Water Sources

A. Have students open their **student booklets** to page 3, *CONNECTION: Water Sources & California*.

B. Read aloud and discuss the questions under **Think About It....**



CONNECTION: Water Sources & California

Think About It...

- Where does the water you drink and use every day come from?
- How much of the water from rain, and other precipitation, is available for us to actually use?

Learn About It...

We get all the water we use from only two places – **on** the ground and **under** the ground.

Surface Water

Water on top of the ground is called surface water. We can see this water in:

- lakes
- rivers
- streams
- oceans

How does the water get there? From rain, of course, and snow and sleet and hail. In California, about 200 million acre-feet of water falls from the sky every year; that's about the same as 200 million football fields each filled a foot deep with water. That's a lot of water. But only about 1/3 of that water actually ends up in rivers, lakes, and streams. The rest of it is either used by trees, plants, and animals or soaks into the ground or evaporates.

Groundwater

Water that soaks into the ground collects in basins called aquifers. These aquifers are not like lakes above ground. They are more like sponges, holding water in spaces between particles of sand and gravel and in cracks in rocks.

California has about 500 aquifers. Some are just the size of small pools; others are miles long and hundreds of feet deep. Some are just a few feet underground; others are thousands of feet underground.

SURFACE WATER

GROUNDWATER

In all of them, the water gets there by soaking into the ground from:

- rain
- irrigation of crops
- river and stream beds
- recharge ponds where water is purposely spread on the ground to refill the aquifer.

That's how water gets into the ground. How do we get it out? Wells are drilled into the ground and electric pumps push the water up to the surface. But even though a lot of water is stored underground, we can't pump it all up. Some of it is too deep and too expensive to reach, and some of it is too salty or too polluted.

Even if we could, we shouldn't pump out all the groundwater because that can cause "overdraft," which causes problems, such as:

- The ground may compact and never be able to hold water again.
- Land may sink, causing buildings, roads, and pipelines to crack or break.
- Plants depending on the groundwater may die.

In California, during most years—

- about 2/3 of the water we use comes from surface water
- about 1/3 of the water we use comes from groundwater.

3

II. Learn About Water Sources

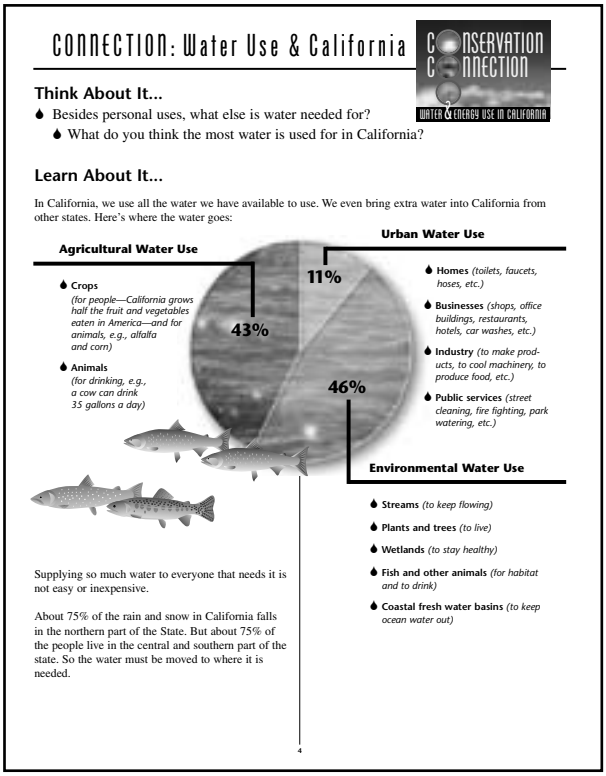
A. Have students read the information on page 3 about surface water and groundwater and use the following questions to generate a discussion.

1. **What happens to all the rain that falls?**
   About 1/3 of the rain that falls ends up in rivers, lakes, and streams. The rest is used by plants and animals, soaks into the ground, and evaporates.
2. **What is surface water?**
   Surface water is all the water we see on the surface of the earth—water in creeks, streams, rivers, lakes, the ocean.
3. **What is groundwater?**
   Groundwater is water under the surface of the earth that collects in aquifers, which are basins underground where water is stored in spaces between particles of sand, gravel, and rock.
4. **How does water get into the ground?**
   Water soaks into the ground from rain, irrigation, river beds, and recharge ponds.
5. **How do we get the water out of the ground?**
   Wells are drilled into the ground and the water is pumped up.
6. **What does "overdraft" mean?**
   "Overdraft" means that too much water has been pumped out of the ground, which can cause land to sink, the aquifer to compact and be unusable, or plants depending on the groundwater to die.
7. **In California, how much of the water we use comes from surface water and how much from groundwater?**
   Most years, about 2/3 of the water we use comes from surface water and about 1/3 comes from groundwater.

III. Think About Water Use

A. Have students turn to page 4 in their **student booklets**.

B. Read aloud and discuss the questions under **Think About It....**



CONNECTION: Water Use & California

CONSERVATION CONNECTION — WATER & ENERGY USE IN CALIFORNIA

Think About It...

- Besides personal uses, what else is water needed for?
- What do you think the most water is used for in California?

Learn About It...

In California, we use all the water we have available to use. We even bring extra water into California from other states. Here's where the water goes:

Agricultural Water Use

- **Crops** *(for people—California grows half the fruit and vegetables eaten in America—and for animals, e.g., alfalfa and corn)*
- **Animals** *(for drinking, e.g., a cow can drink 35 gallons a day)*

43%

Urban Water Use

11%

- **Homes** *(toilets, faucets, hoses, etc.)*
- **Businesses** *(shops, office buildings, restaurants, hotels, car washes, etc.)*
- **Industry** *(to make products, to cool machinery, to produce food, etc.)*
- **Public services** *(street cleaning, fire fighting, park watering, etc.)*

46%

Environmental Water Use

- **Streams** *(to keep flowing)*
- **Plants and trees** *(to live)*
- **Wetlands** *(to stay healthy)*
- **Fish and other animals** *(for habitat and to drink)*
- **Coastal fresh water basins** *(to keep ocean water out)*

Supplying so much water to everyone that needs it is not easy or inexpensive.

About 75% of the rain and snow in California falls in the northern part of the State. But about 75% of the people live in the central and southern part of the state. So the water must be moved to where it is needed.

4

IV. Learn About Water Use

A. Direct students' attention to the graph on page 4. Point out the percentages indicating how much water is needed by each of the sectors.

B. **(optional)** Divide students into four groups:

- agriculture
- environment
- industry and business
- homes and public services

Have each group prepare a brief presentation as to how water is used by their group and why water is so important to their group.

C. Ask students:

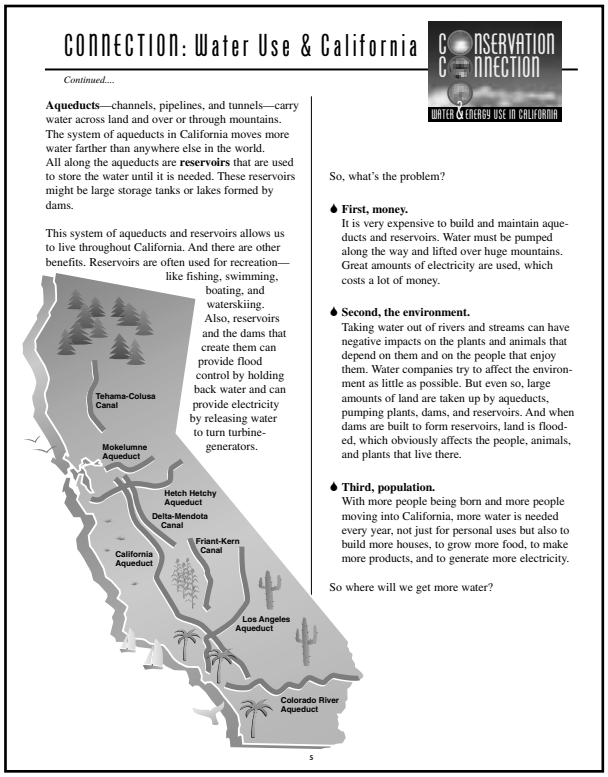
1. **In what category are most of your personal uses of water?**
   Personal uses of water are in the urban category.
2. **How does the use of water in each sector affect you?**
   - We eat the food that is grown by agriculture;
   - we use the products that are made by industry;
   - we shop in the stores and use the services of businesses;
   - we depend on fire fighting, street cleaning, and other public services;
   - we depend on the wetlands and fresh water basins for clean water;
   - we eat fish from rivers, streams, and oceans;
   - we enjoy the beauty and other benefits of the environment.
3. **What sector uses the most water where you live?**
   This, of course, will vary by region. Southern California coastal area has a high urban water use; central California has a high agricultural water use; northern California has a high environmental water use.

D. Read aloud the paragraphs at the bottom of page 4. Emphasize that though most of the water in California is in the northern third, most of the people are in the southern two-thirds.

E. Look at a topographical map of California. Have students note where most of the natural rivers and lakes are and where most of the cities are. Ask students why they think that is.

F. Have students turn to page 5 and read the first col-

umn about the aqueducts and reservoirs that have been built to distribute water to people in California. Have students determine approximately where their city is on the map. Ask if they know the source of water for their city.



CONNECTION: Water Use & California

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

Continued...

Aqueducts—channels, pipelines, and tunnels—carry water across land and over or through mountains. The system of aqueducts in California moves more water farther than anywhere else in the world. All along the aqueducts are **reservoirs** that are used to store the water until it is needed. These reservoirs might be large storage tanks or lakes formed by dams.

This system of aqueducts and reservoirs allows us to live throughout California. And there are other benefits. Reservoirs are often used for recreation—like fishing, swimming, boating, and waterskiing. Also, reservoirs and the dams that create them can provide flood control by holding back water and can provide electricity by releasing water to turn turbine-generators.

Tehama-Colusa Canal
Mokelumne Aqueduct
Hetch Hetchy Aqueduct
Delta-Mendota Canal
Friant-Kern Canal
California Aqueduct
Los Angeles Aqueduct
Colorado River Aqueduct

So, what's the problem?

♦ **First, money.**
It is very expensive to build and maintain aqueducts and reservoirs. Water must be pumped along the way and lifted over huge mountains. Great amounts of electricity are used, which costs a lot of money.

♦ **Second, the environment.**
Taking water out of rivers and streams can have negative impacts on the plants and animals that depend on them and on the people that enjoy them. Water companies try to affect the environment as little as possible. But even so, large amounts of land are taken up by aqueducts, pumping plants, dams, and reservoirs. And when dams are built to form reservoirs, land is flooded, which obviously affects the people, animals, and plants that live there.

♦ **Third, population.**
With more people being born and more people moving into California, more water is needed every year, not just for personal uses but also to build more houses, to grow more food, to make more products, and to generate more electricity.

So where will we get more water?

5

G. Pose the question stated in their booklets: "So what's the problem?" Discuss, as shown on page 5, the three water supply problems facing California—money, the environment, and population.

H. Have students speculate on the question at the bottom of the page—"Where will we get more water?"

V. Continue Tracking Water Use

A. Remind students that they should be keeping track of all the water and energy that they are using today.

B. Check students' *Personal Water & Energy Use* worksheets to be sure they are being filled in and answer any questions students may have.

Extension Activities

- **Research your city's water supply and water uses.** Find out, either through Internet research or by calling your water agency, information about the supply and demand of water in your area.
- **Make pictographs showing the various uses of water in each sector.** Locate pictures, or draw them, showing many different uses of water in agriculture, industry, business, homes, cities, the environment.
- **Begin a water issues file.** Look through newspapers, magazines, and the Internet for articles about water supply in California. Discuss the articles, especially if there are conflicting viewpoints.
- **Demonstrate groundwater and surface water.** Gather the following materials: large glass jar or small aquarium, aquarium gravel, watering can, water, meat baster. Fill the jar or aquarium with gravel, building the ground up slightly higher on one side than the other. Sprinkle water from the watering can into the jar or aquarium to simulate rain. Saturate the ground but do not pour so much that water shows above ground. To simulate the drilling of a well, use the meat baster to pump up some groundwater. Sprinkle more water into the jar or aquarium until a "lake" forms at the low ground end. Experiment with "raining" more and "pumping" more to demonstrate the interaction between groundwater and surface water.

LESSON 3: WATER & THE FUTURE

Lesson Overview

Students will:

- learn about ways to stretch our supply of water—recycling, desalination, conservation
- analyze their personal water use

Vocabulary

- conservation
- desalination
- reclaimed water
- recycled water
- technology

Materials and Preparation

- *Conservation Connection* student booklets
- *Personal Water & Energy Use* worksheets filled in by students
- *How Much Water Does It Use?* information sheet
- make a transparency
- materials for recycling demonstration
  - two clear gallon containers
  - a measuring cup
  - water (175 ounces, about 1½ gallons)
- materials for desalination demonstration
  - teakettle
  - 2 teacups
  - hot plate
  - oven mitt
  - cup of salt water (enough salt added to water to taste the salt)
  - straws

Approximate Time Requirement

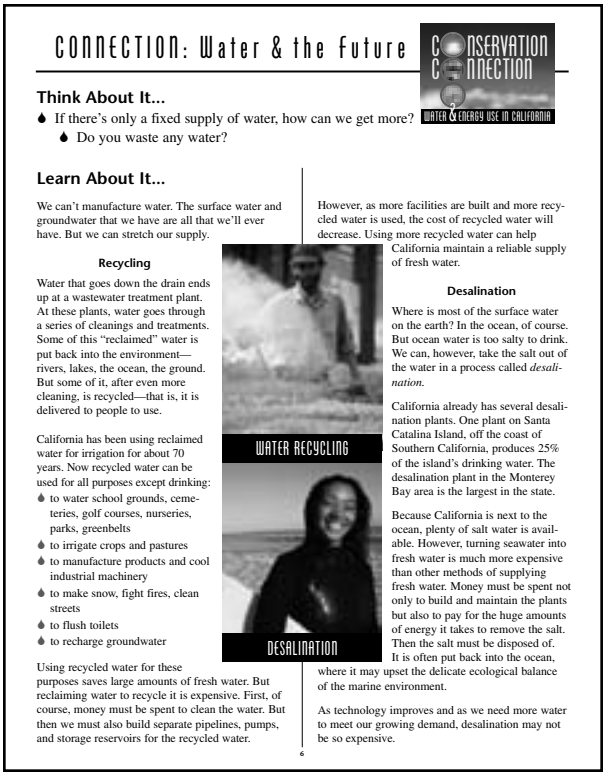
- 1 to 2 class periods

Procedures

I. Think About Water & the Future

A. Have students open their **student booklets** to page 6, *CONNECTION: Water & the Future*.

B. Read aloud and discuss the questions under **Think About It....**



CONNECTION: Water & the Future

Think About It...

- If there's only a fixed supply of water, how can we get more?
- Do you waste any water?

Learn About It...

We can't manufacture water. The surface water and groundwater that we have are all that we'll ever have. But we can stretch our supply.

Recycling

Water that goes down the drain ends up at a wastewater treatment plant. At these plants, water goes through a series of cleanings and treatments. Some of this "reclaimed" water is put back into the environment—rivers, lakes, the ocean, the ground. But some of it, after even more cleaning, is recycled—that is, it is delivered to people to use.

California has been using reclaimed water for irrigation for about 70 years. Now recycled water can be used for all purposes except drinking:

- to water school grounds, cemeteries, golf courses, nurseries, parks, greenbelts
- to irrigate crops and pastures
- to manufacture products and cool industrial machinery
- to make snow, fight fires, clean streets
- to flush toilets
- to recharge groundwater

Using recycled water for these purposes saves large amounts of fresh water. But reclaiming water to recycle it is expensive. First, of course, money must be spent to clean the water. But then we must also build separate pipelines, pumps, and storage reservoirs for the recycled water.

WATER RECYCLING

DESALINATION

However, as more facilities are built and more recycled water is used, the cost of recycled water will decrease. Using more recycled water can help California maintain a reliable supply of fresh water.

Desalination

Where is most of the surface water on the earth? In the ocean, of course. But ocean water is too salty to drink. We can, however, take the salt out of the water in a process called *desalination.*

California already has several desalination plants. One plant on Santa Catalina Island, off the coast of Southern California, produces 25% of the island's drinking water. The desalination plant in the Monterey Bay area is the largest in the state.

Because California is next to the ocean, plenty of salt water is available. However, turning seawater into fresh water is much more expensive than other methods of supplying fresh water. Money must be spent not only to build and maintain the plants but also to pay for the huge amounts of energy it takes to remove the salt. Then the salt must be disposed of. It is often put back into the ocean, where it may upset the delicate ecological balance of the marine environment.

As technology improves and as we need more water to meet our growing demand, desalination may not be so expensive.

6

II. Learn About Recycling

A. Have students read the first paragraph on page 6 under **Learn About It....**

B. Display a clear gallon container and tell students that this container is going to represent the supply of water for homes in their community for a year. Have students fill and mark the container (with tape or marker) as follows:

- add 5 oz., mark the level, and label: DRINKING & COOKING - 5%
- add 5 oz., mark the level, and label: FAUCETS - 5%
- add 12 oz., mark the level, and label: LAUNDRY - 12%
- add 18 oz., mark the level, and label: BATHING - 18%
- add 22 oz., mark the level, and label: TOILETS - 22%
- add 38 oz., mark the level, and label: OUTDOOR USES - 38%

Explain that the percentages indicate the approximate amounts needed by homes in California for each particular use.

C. Ask:

1. What needs the most water?
outdoor uses

2. What uses the most water in the house?
toilets

3. For each use, what happens to the water?
- *For toilets, bathing, laundry, and faucet uses, the water goes down the drain, into the sewer, then to the wastewater treatment plant.*
- *For drinking & cooking, the water is consumed by us.*
- *For outdoor uses, the water soaks into the ground.*

D. Show students the empty container and tell them that it represents the wastewater treatment plant. Have students "dispose" of the water in the first container appropriately—that is:

- use the water labeled OUTDOOR USES to water plants, or trees, or the lawn
- pour the water from FAUCETS, LAUNDRY, BATHING, and TOILETS into the empty container (signifying down the drain to the wastewater treatment plant)
- drink the water labeled DRINKING & COOKING (if you are sure that the water and the container are clean)

E. Ask students to imagine that next year there's a drought and that your community's total supply of water for household uses is now only 3/4 of what it was the year before. Refill the first container with 75 ounces of clean water. *(**Note:** If instead of a drought, the population increased, the original supply might stay the same – 100 ounces – but the amount needed for each of the uses shown on the container would increase. The resulting effect would be the same.)*

F. Ask students:

1. Is there enough water for all the uses?
no

2. How could the supply be extended to have enough?
Water that went down the drain to the wastewater treatment plant could be recycled to water lawns. Also, less water could perhaps be used for some of the other uses.

3. Would there be enough water if some of the water in the wastewater container were used?
yes, with still some left over

4. Is water recycled?
Yes. California has been recycling water to use for irrigation for many years.

G. Have students read the information about *Recycling* in their books on page 6. Discuss:
- What can recycled water be used for?
- Why is recycled water sometimes more expensive?

III. Learn About Desalination

A. Ask students:

1. Where do you see the most surface water when you look at a world map or globe?
in the ocean

2. Why don't we use ocean water?
It's too salty.

3. Is there any way to take the salt out of the water?
yes, through desalination

B. Set up the desalination demonstration:
1. Pour the cup of salt water into the teakettle.
2. Ask a student to use a straw to taste a little of the water and tell the rest of the class how it tastes.
3. Place the teakettle on the hot plate.
4. Heat the salt water until it boils and turns into steam.
5. Put on the oven mitt and hold one teacup upside down over the escaping steam from the teakettle so the water vapor collects in the cup.
6. Place the second teacup underneath so that as the vapor condenses water will drip into the second cup.
7. When most of the water has boiled out of the teakettle, have students taste the water that has collected in the teacup.

Explain that the water has been "distilled," which is one method (though not the one commonly used) to remove salt from water.

C. Have students read the information about *Desalination* in their books on page 6. Discuss:

IV. Learn About Conservation

A. Have students look at page 7 and ask:

1. Why is conservation the best way to stretch our water supply?

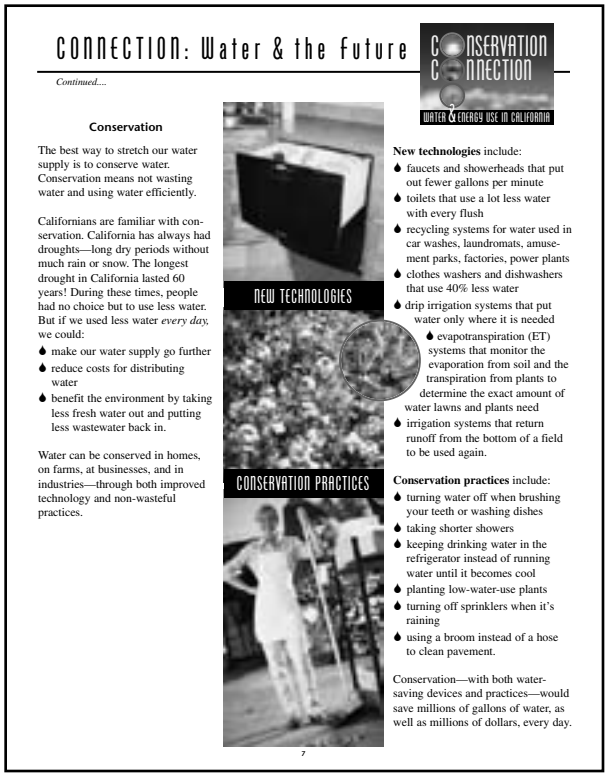
Conservation would:

- increase our supply at no extra cost
- decrease our costs for distributing water
- decrease our costs for cleaning wastewater
- benefit the environment by taking less fresh water out of it and discharging less wastewater into it.

2. What are the two major methods of conserving water?

We can conserve water with:

- new technologies, such as toilets and washers that use less water
- non-wasteful practices, such as taking shorter showers and planting low water-use plants.



CONNECTION: Water & the Future

Continued....

Conservation

The best way to stretch our water supply is to conserve water. Conservation means not wasting water and using water efficiently.

Californians are familiar with conservation. California has always had droughts—long dry periods without much rain or snow. The longest drought in California lasted 60 years! During these times, people had no choice but to use less water. But if we used less water *every day,* we could:

- make our water supply go further
- reduce costs for distributing water
- benefit the environment by taking less fresh water out and putting less wastewater back in.

Water can be conserved in homes, on farms, at businesses, and in industries—through both improved technology and non-wasteful practices.

NEW TECHNOLOGIES

CONSERVATION PRACTICES

New technologies include:

- faucets and showerheads that put out fewer gallons per minute
- toilets that use a lot less water with every flush
- recycling systems for water used in car washes, laundromats, amusement parks, factories, power plants
- clothes washers and dishwashers that use 40% less water
- drip irrigation systems that put water only where it is needed
- evapotranspiration (ET) systems that monitor the evaporation from soil and the transpiration from plants to determine the exact amount of water lawns and plants need
- irrigation systems that return runoff from the bottom of a field to be used again.

Conservation practices include:

- turning water off when brushing your teeth or washing dishes
- taking shorter showers
- keeping drinking water in the refrigerator instead of running water until it becomes cool
- planting low-water-use plants
- turning off sprinklers when it's raining
- using a broom instead of a hose to clean pavement.

Conservation—with both water-saving devices and practices—would save millions of gallons of water, as well as millions of dollars, every day.

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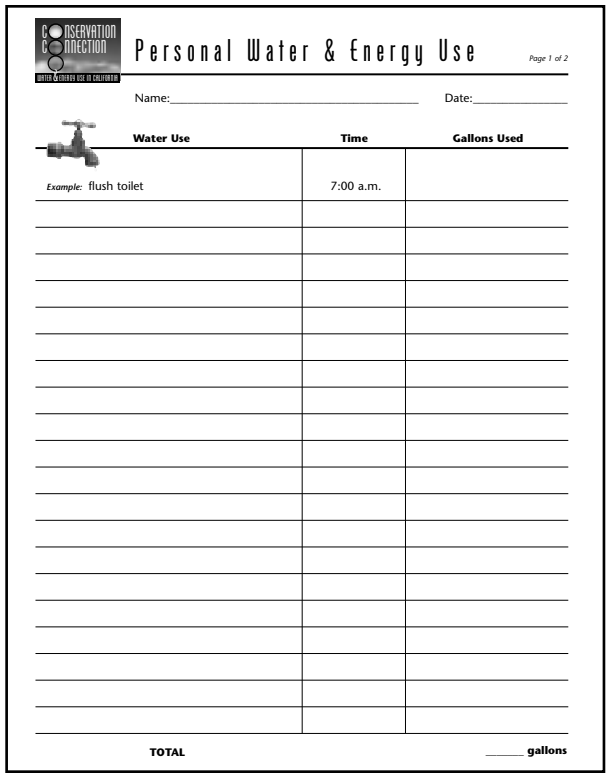
B. Have students brainstorm ways to conserve water. Tell them that when they analyze their *Home Water & Energy Surveys* they will learn more about ways to save water.

V. Calculate Personal Water Use

A. Ask students to take out their ***Personal Water & Energy Use*** worksheets. Take a quick tally to see what **water** uses were most common among students.



Personal Water & Energy Use

Page 1 of 2

Name:_____ Date:_____

Water Use	Time	Gallons Used
Example: flush toilet	7:00 a.m.	
TOTAL		_____ gallons

B. Show the transparency ***How Much Water Does It Use?*** Point out to students that for each use two amounts are shown—a regular amount and a water conserving amount.

C. Have students fill in the amounts of water for each water use they have listed. For any uses not shown on the transparency, have students estimate the amount of water they used based on figures for other uses.

D. Have students total the number of gallons they used for one day. Add up the total number of gallons used by the class and divide by the number of students in the class to determine the average amount used per person.

E. Tell students that:

- indoors, each person in California uses approximately 100 gallons of water each day
- outdoors, on average, each person uses almost another 100 gallons of water each day
- a family of 5 needs about 326,000 gallons of water a year—that's an acre-foot of water, which is enough to fill a football field a foot deep.

Compare these figures to your class average and discuss why there might be differences.

F. Ask students if from this list they can see any areas where they could conserve water.

G. Use students' personal use water figures to do some math exercises based on the level of the class.
   - Use the average daily use per person to estimate the total daily use for the entire school, for the community, for the state (approximately 35 million people).
   - Figure the number of gallons a person would use in a year... in his/her entire life so far... by the time he/she is 45 and 85.
   - Calculate how much water would be saved if everyone in the class used a low-flow showerhead instead of a regular showerhead for a day, a month, a year.
   - Figure how much water could be conserved in one day by using all the water-saving methods.
   - Calculate how many fewer gallons they would have to use to reduce their water use by 10%, by 20%.

*(**NOTE:** Keep the Personal Water & Energy Use worksheets to calculate energy use in Lesson 5.)*

Extension Activities

- **Conduct a shower versus bath experiment** Have all students who have bathtubs at home fill their tubs to take a bath, but tell them that before they get in the tub to measure the depth of water. Make a chart in class recording the various depths of water. Next, tell students to take a shower in the same bathtub, but before they begin they should close the bathtub drain so that the water will collect in the tub. Tell them to time their shower and to measure the depth of water that has collected in the tub when they are finished. Record the figures on the chart and compare.
- **Research conservation products and report on water savings.** Determine an average cost for various new water-saving products (e.g., Energy Star washing machine, low-flow showerhead), and calculate how much water is saved and how long the product will take to pay for itself.
- **Investigate indirect uses of water**—that is, water that they do not use first-hand but that is needed to make products they use or to provide services they use. How much water is needed for such indirect water uses as: generating electricity, growing wheat to make bread, manufacturing a car, raising a cow, cleaning streets.
- **Research and design a graywater reclamation system.** Find out how various designs work for recycling water at home, what regulations must be followed, and what problems might exist? Have the class work in teams to design a system for a new home that is being built.
- **Research the economics of recycling water.** Compare using recycled water to using imported water. What are differences in cost? What are the advantages and disadvantages of each?

LESSON 4: ENERGY SUPPLY & DEMAND

✪ Lesson Overview

Students will:

- prepare and give presentations on the various energy sources we currently use
- determine how energy is used in California
- discuss the problem of energy supply meeting energy demand

✪ Vocabulary

- biomass
- fission
- fossil fuels
- geothermal
- hydropower
- nuclear power
- petrochemicals
- photovoltaic
- solar
- thermal
- turbine-generator
- uranium

✪ Materials and Preparation

- *Conservation Connection* student booklets
- *Energy Source Comparison* worksheet
  - copy for each student or group
- materials to make posters

✪ Approximate Time Requirement

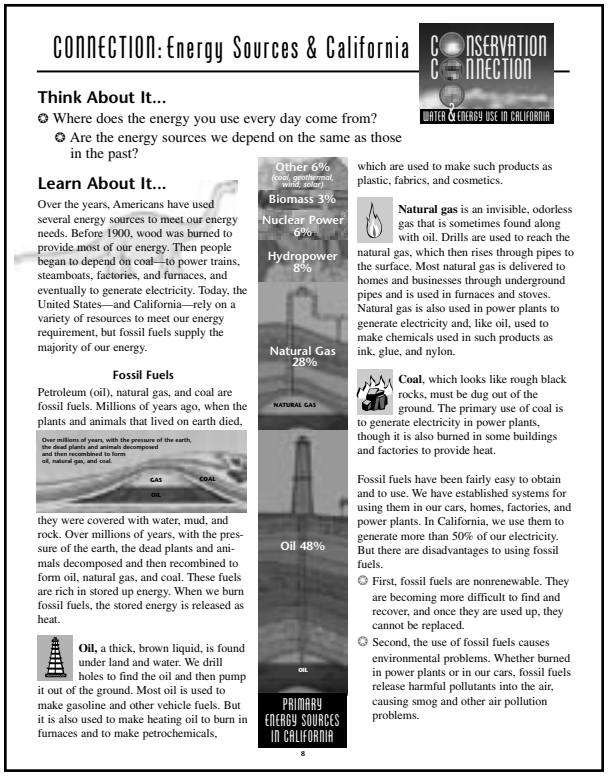
- 2-3 class periods, depending on time to prepare and give presentations

✪ Procedures

I. Think About Energy Sources

A. Have students open their **student booklets** to page 8, *CONNECTION: Energy Sources & California*.

B. Read aloud and discuss the questions under **Think About It....**



CONNECTION: Energy Sources & California

Think About It...

✪ Where does the energy you use every day come from?

✪ Are the energy sources we depend on the same as those in the past?

Learn About It...

Over the years, Americans have used several energy sources to meet our energy needs. Before 1900, wood was burned to provide most of our energy. Then people began to depend on coal—to power trains, steamboats, factories, and furnaces, and eventually to generate electricity. Today, the United States—and California—rely on a variety of resources to meet our energy requirement, but fossil fuels supply the majority of our energy.

Fossil Fuels

Petroleum (oil), natural gas, and coal are fossil fuels. Millions of years ago, when the plants and animals that lived on earth died, they were covered with water, mud, and rock. Over millions of years, with the pressure of the earth, the dead plants and animals decomposed and then recombined to form oil, natural gas, and coal. These fuels are rich in stored up energy. When we burn fossil fuels, the stored energy is released as heat.

Over millions of years, with the pressure of the earth, the dead plants and animals decomposed and then recombined to form oil, natural gas, and coal.

GAS COAL OIL

Oil, a thick, brown liquid, is found under land and water. We drill holes to find the oil and then pump it out of the ground. Most oil is used to make gasoline and other vehicle fuels. But it is also used to make heating oil to burn in furnaces and to make petrochemicals, which are used to make such products as plastic, fabrics, and cosmetics.

Other 6% (coal, geothermal, wind, solar)
Biomass 3%
Nuclear Power 6%
Hydropower 8%
Natural Gas 28%
NATURAL GAS
Oil 48%
OIL
PRIMARY ENERGY SOURCES IN CALIFORNIA

Natural gas is an invisible, odorless gas that is sometimes found along with oil. Drills are used to reach the natural gas, which then rises through pipes to the surface. Most natural gas is delivered to homes and businesses through underground pipes and is used in furnaces and stoves. Natural gas is also used in power plants to generate electricity and, like oil, used to make chemicals used in such products as ink, glue, and nylon.

Coal, which looks like rough black rocks, must be dug out of the ground. The primary use of coal is to generate electricity in power plants, though it is also burned in some buildings and factories to provide heat.

Fossil fuels have been fairly easy to obtain and to use. We have established systems for using them in our cars, homes, factories, and power plants. In California, we use them to generate more than 50% of our electricity. But there are disadvantages to using fossil fuels.

✪ First, fossil fuels are nonrenewable. They are becoming more difficult to find and recover, and once they are used up, they cannot be replaced.

✪ Second, the use of fossil fuels causes environmental problems. Whether burned in power plants or in our cars, fossil fuels release harmful pollutants into the air, causing smog and other air pollution problems.

8

II. Prepare Student Presentations

A. Have students read the first paragraph on page 8 under **Learn About It....**

B. Tell students that to learn more about our energy resources, each of them is going to become an "expert" about a certain energy source and will then inform the rest of the class about that source.

C. Divide the class into seven groups, one for each of the energy sources described in their books:

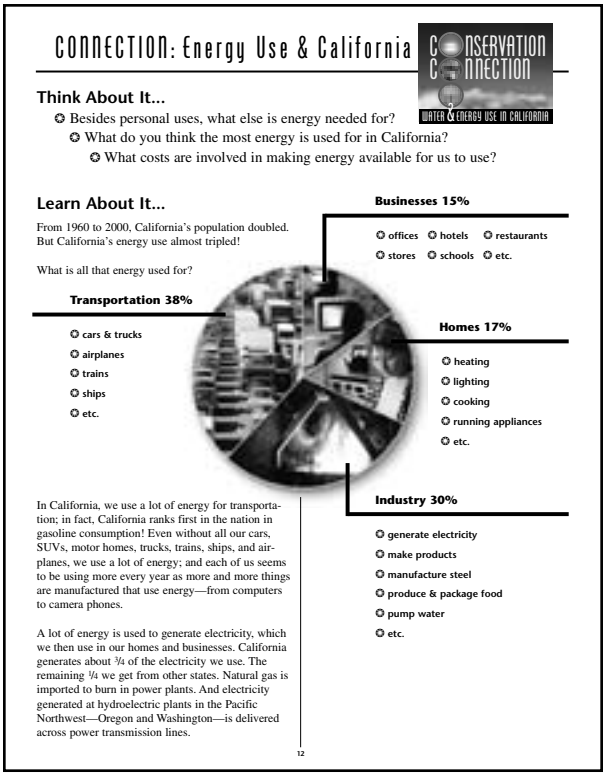
- fossil fuels
- biomass
- wind
- hydropower
- geothermal
- solar
- nuclear power

D. Explain that each group should use the information in their books plus whatever other information they gather to become "experts" about their energy source. Tell students that each group is to prepare a poster and a brief report about their source but can also use other methods to present their information to the rest of the class.

E. Inform students how long you are giving them to prepare their presentations, when they will give their presentations, and about how long each presentation should be.

III. Think About Energy Use

A. Have students look at page 12 in their **student booklets**, *CONNECTION: Energy Use & California*.



CONNECTION: Energy Use & California

Think About It...

✪ Besides personal uses, what else is energy needed for?

✪ What do you think the most energy is used for in California?

✪ What costs are involved in making energy available for us to use?

Learn About It...

From 1960 to 2000, California's population doubled. But California's energy use almost tripled!

What is all that energy used for?

Businesses 15%

✪ offices ✪ hotels ✪ restaurants
✪ stores ✪ schools ✪ etc.

Transportation 38%

✪ cars & trucks
✪ airplanes
✪ trains
✪ ships
✪ etc.

Homes 17%

✪ heating
✪ lighting
✪ cooking
✪ running appliances
✪ etc.

Industry 30%

✪ generate electricity
✪ make products
✪ manufacture steel
✪ produce & package food
✪ pump water
✪ etc.

In California, we use a lot of energy for transportation; in fact, California ranks first in the nation in gasoline consumption! Even without all our cars, SUVs, motor homes, trucks, trains, ships, and airplanes, we use a lot of energy; and each of us seems to be using more every year as more and more things are manufactured that use energy—from computers to camera phones.

A lot of energy is used to generate electricity, which we then use in our homes and businesses. California generates about ¾ of the electricity we use. The remaining ¼ we get from other states. Natural gas is imported to burn in power plants. And electricity generated at hydroelectric plants in the Pacific Northwest—Oregon and Washington—is delivered across power transmission lines.

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B. Read aloud and discuss the questions under **Think About It....**

IV. Learn About Energy Use

A. Read the statistics under **Learn About It...**
"

From 1960 to 2000, California's population doubled. But California's energy use almost tripled!"

Point out that means each person is using more energy. Ask students why they think that's true. *(We have more products that use energy; we have bigger houses; we drive more; etc.)*

B. Direct students' attention to the graph on page 12. Ask:

1. **In what categories are you responsible for the use of energy?**
   All of them. We personally use energy in our homes. We attend school and shop in stores. We use products that are made by industry. And we ride in cars, buses, trains, and/or airplanes, as well as use products that are transported by ships, trucks, trains, and planes.
2. **What provides the energy needed in each sector?**
   The transportation sector uses mainly oil, which is made into gasoline and other fuels. Homes, businesses, and industries depend mostly on natural gas and on electricity.
3. **What energy sources are used to generate electricity?**
   All energy sources—fossil fuels, hydropower, nuclear power, biomass, geothermal, wind, solar—can be used to generate electricity.
   (NOTE: Have students look at the information under each energy source on pages 8-11 to find out and graph how much electricity each source generates in California.)
   In California, electricity is generated by:
   - *fossil fuels (primarily natural gas) – more than 50%*
   - *hydropower – about 23%*
   - *nuclear power – about 16%*
   - *geothermal – about 5%*
   - *biomass – about 2%*
   - *wind – about 1%*
   - *solar – less than 1%*

C. Read the paragraphs at the bottom of page 12 and then pose the question stated at the top of page 13: "So what's the problem?"

D. Discuss, as shown on page 13, the problems we face in California, and the nation, concerning our use of energy—supply, environment, money, population.

CONNECTION: Energy Use & California

CONSERVATION CONNECTION — WATER & ENERGY USE IN CALIFORNIA

Continued....

So what's the problem?

First, supply.
The amount of energy we have doesn't always match the amount we need. In the 1970s, the "energy crisis" had us waiting in long lines and paying high prices to buy gasoline, sometimes only on specified days. Because we depend on other countries for much of the oil we need to manufacture gasoline, our supply is not always certain.

In 2001, the "energy crisis" caused "rolling blackouts" throughout California, meaning that various areas were without electricity for periods of time. Along with other factors, the shortage of electricity was caused by:
- more demand during hot summer weather
- less supply from the hydroelectric plants in the Pacific Northwest where rainfall was low.

Second, the environment.
Most of our energy comes from burning fossil fuels, which emit pollutants into our air. In California, and other places, these pollutants cause smog. In other parts of the country, fossil fuels also contribute to acid rain; and in the world they may be causing global warming.

Other energy sources also impact the environment—whether taking up space, flooding land behind dams, or creating radioactive waste. The more energy we use, the more the environment is affected.

SUPPLY

ENVIRONMENT

POPULATION

Third, money.
It's expensive to supply the energy we need. Fossil fuels must be drilled for or dug out of the ground and transported to where they are needed; power plants must be built; transmission lines must be connected. When we import energy, even more money must be spent. As the demand goes up and our supply goes down, consumers will be spending even more each month for the energy they use.

Fourth, population.
California is the fastest growing state in the nation.
- In 2004, our population was approximately 35 million.
- By 2050, it is projected to be 55 million.

Energy will be needed to make the products and distribute the water consumed by all these people. And, of course, each person will use energy every day just to live their lives.

So how will we have enough energy for the future?

13

E. Have students speculate on the question at the bottom of the page—"How will we have enough energy for the future?"

V. Conduct Presentations

A. Distribute to each student or work group a copy of the ***Energy Source Comparison*** worksheet. Explain to students that as they listen to each presentation, they should be fill in the worksheet indicating the advantages and disadvantages of each energy source. Tell them to pay particular attention to the areas of:
   - cost
   - supply
   - environmental effects

B. Have each "expert" group present their poster and information about their energy source. After each presentation, ask the class if they have any questions to ask the experts.

C. Display the posters around the room.

VI. Compare Energy Sources

A. When all the presentations have been completed, discuss the *Energy Source Comparison* worksheet using the sample responses below as a guide.

B. Point out to students that every energy source has advantages and disadvantages and that meeting our energy needs is not easy.

SAMPLE RESPONSES

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

Energy Source Comparison

What are some advantages and disadvantages of each of our energy sources?

Think about: **supply** **cost** **environmental effects**

Energy Source	Advantages	Disadvantages
fossil fuels	*Fairly easy to obtain and to use* *Systems in place to use them in our cars, homes, factories, and power plants*	*Nonrenewable* *Dependence on other countries for the amount we use* *Becoming more difficult to find and get out of the ground so costs continue to increase* *Contribute to air pollution*
hydropower	*Renewable* *Don't have to pay for water* *Clean for the environment*	*Only a limited number of places with water that can be used for hydropower*
nuclear power	*Large supply since uranium, the fuel, is a common mineral found around the world* *Not expensive because uranium is common*	*Radioactive waste, which can be harmful to us*
biomass	*Renewable* *Inexpensive fuel (trash and plant waste)*	*Pollutants released into the air when trash is burned*
geothermal	*Renewable* *Don't have to pay for fuel* *Clean for the environment*	*Only in areas where heat is close to the surface* *Costs to build special power plants and to reinject water into the ground*
wind power	*Renewable* *Don't have to pay for wind* *Clean for the environment*	*Not reliable since winds must blow at a constant high speed*
solar	*Renewable* *Don't have to pay for sunshine* *Clean for the environment*	*Not reliable since the sun doesn't always shine* *Needs special power plants and special equipment—solar cells and solar collectors*

Extension Activities

- **Demonstrate air pollution**. Gather the following materials: white porcelain cup or plate, candle, matches. Tell students that you are going to demonstrate how fossil fuels produce pollution.
  - Light the candle. Explain that the candle is made, in part, from oil, a fossil fuel.
  - Briefly place the cup or plate near the top of the flame until a black smudge appears; then remove the cup from the flame.
  - Wipe off part of the black soot with a tissue to show that the cup was not burned or scorched. Ask students why they think the cup turned black.
  - Explain that burning the candle releases hot gases and tiny particles—air emissions—which rise quickly up into the air; some of the emissions are invisible and some can be seen as smoke. When the smoke settles on a surface, it produces soot.
  - Tell students that burning a candle produces very few air emissions; but burning fossil fuels in cars, power plants, factories, and other buildings produces a lot of air emissions that can cause air pollution.
- **Identify fossil fuel products.** Remind students that fossil fuels are used to make chemicals that are used to produce many products that we use every day. Give students a few examples of fossil fuels products:
  - Plastic—bags, balls, toothbrushes, dishes, furniture
  - Fabric—polyester, nylon, vinyl
  - Medicine—cough syrup, aspirin
  - Cosmetics—hand lotion, nail polish, shampoo
  - Other products—floor wax, glue, film, ink, insect spray

  Have students identify various objects around the classroom that are made from fossil fuels.
- **Play "What Am I?"** Divide students into two (or more) teams. Either alternate having the teams answer or pose the question to all teams and allow the first team that raises a hand (or rings a bell or calls a name) to answer. State various facts, including advantages and disadvantages, about an energy source and have students guess the source. For example: "I'm renewable; I do not create air pollution; I use falling water to create electricity." *(hydropower)*
- **Make a solar collector.** Gather the following materials: black plastic trash bag, rubber hose about 2 or 3 feet long, thick rubber band, string, water. Tell students that they are going to make a solar collector to heat water.
  - Fill the plastic bag about half full with water.
  - Insert one end of the rubber hose into the top of the bag and secure the bag around the hose with the rubber band.
  - Tie the string tightly around the plastic bag just under the end of the hose in the bag.
  - Lay the bag in the sun for at least one hour.
  - Hold the bag upside down. Untie the string around the bag and carefully feel the water than runs out through the hose.
- **Measure and compare wind speed**. Find the windiest spot at your school and use an anemometer to measure the wind speed at various heights, times of day, times of year.
- **Demonstrate a turbine**. Use a toy pinwheel (or construct a metal pinwheel out of a can lid) to demonstrate how the blades are turned by steam, falling water, and wind.

LESSON 5: ENERGY & THE FUTURE

✪ Lesson Overview

Students will:

- learn about ways to meet our energy demand in the future, including energy efficient products, renewables, fuel cells, and conservation
- analyze their personal energy use
- calculate the cost of the energy they use.

✪ Vocabulary

- BTU
- efficiency
- fuel cell
- kilowatt hour
- sustainable

✪ Materials and Preparation

- *Conservation Connection* student booklets
- *Personal Water & Energy Use* worksheets filled in by students
- *How Much Energy Does It Use?* information sheet
  - make a transparency
- an electricity bill and a natural gas bill
  - bring in the bills and find the cost per kilowatt hour for electricity and the cost per BTU for natural gas

  OR
  - call or check online to determine the costs

✪ Approximate Time Requirement

- 1-2 class periods

✪ Procedures

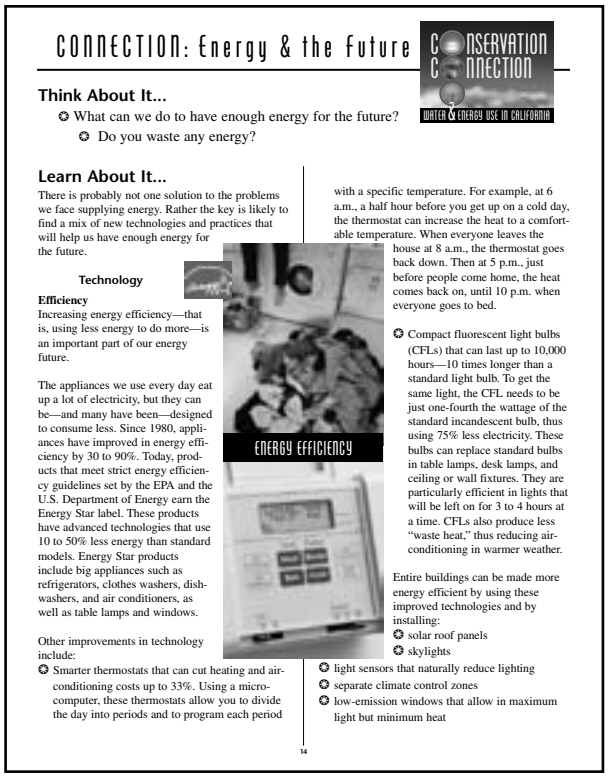
I. Think About Energy & the Future

A. Have students open their student booklets to page 14, *CONNECTION: Energy & the Future*.

B. Read aloud and discuss the questions under **Think About It....**

II. Learn About Energy & The Future

A. Read aloud the first paragraph under **Learn About It...** on page 14.



CONNECTION: Energy & the Future

Think About It...

✪ What can we do to have enough energy for the future?

✪ Do you waste any energy?

Learn About It...

There is probably not one solution to the problems we face supplying energy. Rather the key is likely to find a mix of new technologies and practices that will help us have enough energy for the future.

Technology

Efficiency

Increasing energy efficiency—that is, using less energy to do more—is an important part of our energy future.

The appliances we use every day eat up a lot of electricity, but they can be—and many have been—designed to consume less. Since 1980, appliances have improved in energy efficiency by 30 to 90%. Today, products that meet strict energy efficiency guidelines set by the EPA and the U.S. Department of Energy earn the Energy Star label. These products have advanced technologies that use 10 to 50% less energy than standard models. Energy Star products include big appliances such as refrigerators, clothes washers, dishwashers, and air conditioners, as well as table lamps and windows.

Other improvements in technology include:

✪ Smarter thermostats that can cut heating and air-conditioning costs up to 33%. Using a microcomputer, these thermostats allow you to divide the day into periods and to program each period with a specific temperature. For example, at 6 a.m., a half hour before you get up on a cold day, the thermostat can increase the heat to a comfortable temperature. When everyone leaves the house at 8 a.m., the thermostat goes back down. Then at 5 p.m., just before people come home, the heat comes back on, until 10 p.m. when everyone goes to bed.

ENERGY EFFICIENCY

✪ Compact fluorescent light bulbs (CFLs) that can last up to 10,000 hours—10 times longer than a standard light bulb. To get the same light, the CFL needs to be just one-fourth the wattage of the standard incandescent bulb, thus using 75% less electricity. These bulbs can replace standard bulbs in table lamps, desk lamps, and ceiling or wall fixtures. They are particularly efficient in lights that will be left on for 3 to 4 hours at a time. CFLs also produce less "waste heat," thus reducing air-conditioning in warmer weather.

Entire buildings can be made more energy efficient by using these improved technologies and by installing:

✪ solar roof panels

✪ skylights

✪ light sensors that naturally reduce lighting

✪ separate climate control zones

✪ low-emission windows that allow in maximum light but minimum heat

14

B. Have students read the text on pages 14 and 15. Then use the questions below to briefly discuss what they read. **Alternatively**, write the questions on the chalkboard, divide students into groups, and have each group answer the questions using the information on pages 14 and 15.

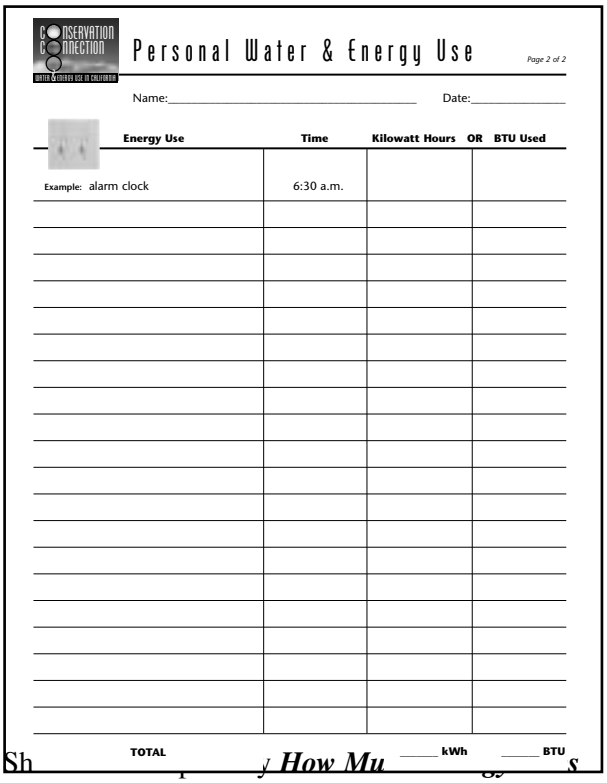
1. **What does it mean to increase energy efficiency?**
   It means using less energy to do the same or more work.
2. **Are appliances today more or less efficient than in the past?**
   Appliances today are more efficient. Since 1980, appliances—such as refrigerators, dishwashers, clothes dryers—have improved in energy efficiency by 30 to 90%, depending on the product. Today, Energy Star rated products have advanced technologies that use 10 to 15% less energy than standard models.
3. **How can a thermostat help us use less energy?**
   Some thermostats can be programmed to automatically change the setting at various times of the day. That means that the heat or the air conditioning can be programmed to go up or down or off so that the heat or AC is not accidentally left on when it isn't needed.
4. **How much less energy does a compact**

fluorescent light bulb use than a standard incandescent bulb?
A compact fluorescent light bulb uses 75% less electricity than a standard light bulb, and it can last up to 10 times longer.

5. **Why don't we use more renewable energy sources now?**
Compared to fossil fuels, renewable energy sources have been expensive, less efficient, and more difficult to use.
6. **What are the benefits of using more renewable energy sources?**
Renewable energy sources are:
   - *sustainable, meaning they will never run out*
   - *non-polluting for our air and water*
   - *available in the United States, which means we do not have to depend on other countries for them.*
7. **How does a fuel cell work?**
In a fuel cell, hydrogen and oxygen are combined to produce electricity; no fuel is burned.
8. **What are the advantages and disadvantages to using fuel cells?**
An advantage to using fuel cells is that they produce no pollution; the only emissions from a fuel cell are heat and pure water vapor. The disadvantages are that hydrogen is very expensive and it is difficult to store.
9. **Why do each of us use more energy today than we did in the past?**
Although energy efficiency of appliances has improved, we have more "things" that use energy. Also, many of our appliances have a "stand-by" mode, which continues to use energy even when the appliance is turned off.
10. **What are the benefits of conserving energy?**
By conserving energy, which means using it wisely and not wasting it, we can:
   - *save money*
   - *put fewer pollutants into the environment*
   - *have more energy available for the future.*

III. Calculate Personal Energy Use

A. Ask students to take out their ***Personal Water & Energy Use*** worksheets. Take a quick tally to see what **energy** uses were most common among students.



Personal Water & Energy Use

Page 2 of 2

Name:_____ Date:_____

Energy Use	Time	Kilowatt Hours OR	BTU Used
Example: alarm clock	6:30 a.m.		
TOTAL		_____ kWh	_____ BTU

B. Sh[illegible] ***How Mu[illegible] s It Use?*** Point out to students that:

- The amount of energy used by electric appliances is measured in watts. Our use of electricity is measured by kilowatt hours. One kilowatt-hour (kWh) is 1,000 watts of electricity use for one hour. That would be the same as a 1,000 watt hair dryer used for one hour, or a 100 watt incandescent light bulb burning for 10 hours.
- The amount of energy used by appliances that run on natural gas is measured in BTU, which stands for British Thermal Units. One BTU signifies the quantity of heat needed to raise the temperature of one pound of water by 1 degree Fahrenheit; it is a very small unit.

C. Have students fill in the number of kWh for each electrical appliance they used. Tell them that if

any of their appliances—furnace, clothes dryer, water heater, or stove—uses natural gas instead of electricity, they should fill in the BTU figure. *(**NOTE**: If students aren't sure, just have them use the kWh figure.)* For any uses not shown on the transparency, have students estimate the number based on figures for other uses.

D. Have students figure the total number of kilowatt hours and BTU they used for one day. (***NOTE**: You can convert all numbers to kWh using this formula: 3,413 BTUs = 1 kWh.)* Add up the total numbers used by the class and divide by the number of students in the class to determine the average amount used per person.

E. Tell students that figures indicating the average use of energy per person per day in California vary widely. Remind them that each person is responsible for not only **direct** energy usage but also **indirect** usage—the energy needed to make the products and grow the food that each of us uses.

F. Tell students that the average electricity use **per household** is calculated to be about 17 kilowatt hours per day. Explain that in a household, often several people at the same time use the same light, watch the same television, use the same heater, and so on.

G. Show students an electricity bill and a natural gas bill and point out the cost per kilowatt hour of electricity and cost of natural gas. Point out that natural gas is usually billed in *therms* and that one therm equals 100,000 BTU.(**Alternatively**, simply tell them the cost that you learned from your electricity and gas companies.)

H. Use students' personal use energy figures to do some math exercises based on the costs of electricity and natural gas in your area.
   - Figure the cost of the electricity and natural gas that they used.
   - Use the average daily kWh use per person to estimate the total daily use and cost for the entire school, for the community, for the state (approximately 35 million people).
   - Figure the number of kWh a person would use in a year... in his/her entire life so far... by the time he/she is 45 and 85. Then figure the costs.

- **Determine costs**. Use the following formula to figure the cost of using various electrical appliances:

  Watts x Hours Used x Cost = Operating Cost

- **Research conservation products and report on savings**. Determine an average cost for various new energy-saving products (e.g., Energy Star clothes dryer, programmable thermostat, low-emission windows) and calculate how much energy is saved and how long the product will take to pay for itself.

- **Demonstrate efficiency**. Gather the following materials: pots or pans of the same shape and size but of different materials (e.g., glass, steel, copper), hot plate, water, stopwatch. Heat equal amounts of the same temperature water in each pan until the water boils. Record the times and determine which material had the best heating efficiency.

- **Experiment with lighting**. Gather the following materials: photographer's light meter, fluorescent and incandescent light bulbs of equal wattage, a lamp that can use either bulb. In a darkened room, turn on the incandescent light. Use the light meter to measure the amount of light given off at distances of 3 and 10 feet from the light. Record the findings. Carefully touch the bulb after it has been on for a few minutes to determine how hot it is. Follow the same procedures using the fluorescent bulb. Determine which is more efficient and why.

- **Test low-emission windows.** Gather the following materials: sheet of ordinary glass, sheet of low-emission glass, two identical boxes, two thermometers. Put a thermometer inside each box and place a sheet of glass on top of each box. Put the boxes next to each other outside in the sun. Measure and record the temperatures inside each box every 15 minutes. Expose the boxes to different conditions (e.g., sunny day, overcast day, tree-shaded) and compare the differences.

LESSON 6: HOME WATER & ENERGY SUR-

✪ Lesson Overview

Students will:

- analyze their *Home Water & Energy Surveys* to determine areas where they could improve conservation at home
- review ways to save water and energy at home
- develop personal and family conservation plans
- evaluate and revise plans

✪ Vocabulary

- aerator
- caulk
- displacement
- hybrid
- insulation
- mulch
- weather strip
- xeriscape

✪ Materials and Preparation

- *Home Water & Energy Survey* completed by each student
- *Ways to Save Water & Energy at Home* (5 pages)
  - make a transparency of each page
- *SUMMARY of Ways to Save Water & Energy at Home* (2 pages)
  - copy for each student (back-to-back if possible)
- *Personal Water & Energy Conservation Plan*
  - copy for each student or have students make their own on notebook paper
- *Family Water & Energy Conservation Plan*
  - copy for each student or have students make their own on notebook paper

✪ Approximate Time Requirement

- 1 class period to analyze and make personal plans
- 1 class period to evaluate personal and family plans and calculate savings

✪ Procedures

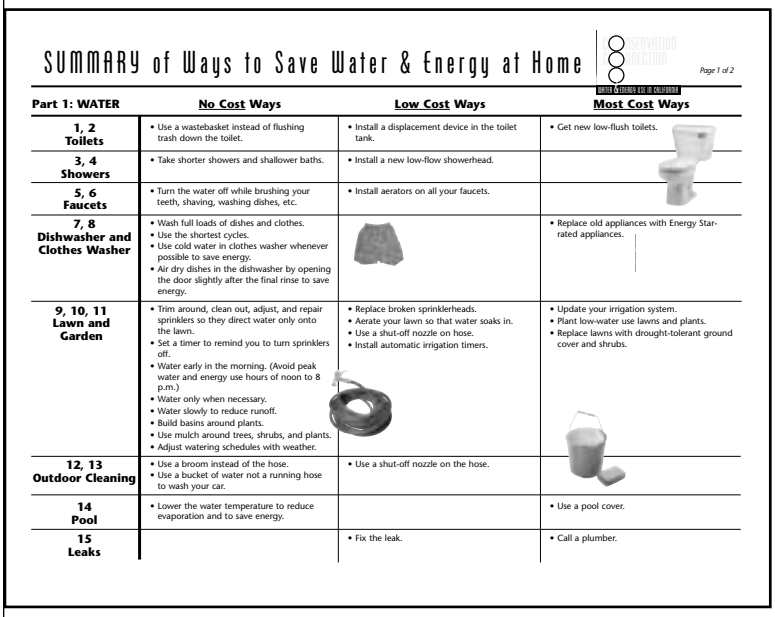
I. Analyze Completed Home Surveys

A. Have students get out their *Home Water & Energy Survey.* Ask how they did on the survey.
   1. **Did your families get involved?**
   2. **What did your families say?**
   3. **Did you find any areas needing improvement?**

B. Tell students to circle on their surveys the number of any item that was marked **b** or **c** . Explain that these answers indicate either a "waster" activity or a "don't know" response.

C. Take a quick tally to see which items were circled the most.

D. Explain that for every item there are recommendations for "ways to save" water or energy. Distribute a copy of the ***SUMMARY of Ways to Save Water & Energy at Home*** to each student. Explain that this sheet summarizes the complete recommendations that they will discuss using the overhead. Have students circle those items on the summary that they circled on their surveys.



SUMMARY of Ways to Save Water & Energy at Home

Page 1 of 2

Part 1: WATER	No Cost Ways	Low Cost Ways	Most Cost Ways
1, 2 Toilets	• Use a wastebasket instead of flushing trash down the toilet.	• Install a displacement device in the toilet tank.	• Get new low-flush toilets.
3, 4 Showers	• Take shorter showers and shallower baths.	• Install a new low-flow showerhead.	
5, 6 Faucets	• Turn the water off while brushing your teeth, shaving, washing dishes, etc.	• Install aerators on all your faucets.	
7, 8 Dishwasher and Clothes Washer	• Wash full loads of dishes and clothes. • Use the shortest cycles. • Use cold water in clothes washer whenever possible to save energy. • Air dry dishes in the dishwasher by opening the door slightly after the final rinse to save energy.		• Replace old appliances with Energy Star-rated appliances.
9, 10, 11 Lawn and Garden	• Trim around, clean out, adjust, and repair sprinklers so they direct water only onto the lawn. • Set a timer to remind you to turn sprinklers off. • Water early in the morning. (Avoid peak water and energy use hours of noon to 8 p.m.) • Water only when necessary. • Water slowly to reduce runoff. • Build basins around plants. • Use mulch around trees, shrubs, and plants. • Adjust watering schedules with weather.	• Replace broken sprinklerheads. • Aerate your lawn so that water soaks in. • Use a shut-off nozzle on hose. • Install automatic irrigation timers.	• Update your irrigation system. • Plant low-water use lawns and plants. • Replace lawns with drought-tolerant ground cover and shrubs.
12, 13 Outdoor Cleaning	• Use a broom instead of the hose. • Use a bucket of water not a running hose to wash your car.	• Use a shut-off nozzle on the hose.	
14 Pool	• Lower the water temperature to reduce evaporation and to save energy.		• Use a pool cover.
15 Leaks		• Fix the leak.	• Call a plumber.

E. Project the transparencies of ***Ways to Save Water & Energy at Home*** and review the recommendations, especially in the areas where students had items circled. Explain that the second column provides a little information about why it is important to save water or energy in that area *(for example, heating and cooling)*; the other columns describe what actions could be taken in their homes to conserve water and energy. Point out that there are various levels of cost for implementing these recommendations—from no cost to quite a lot.

F. Explain that many of the recommendations relate directly to the items on the survey—for example: "wash full loads in clothes washer" and "turn down the heater thermostat." But point out that there are also other recommendations in each area—for example: "use the shortest cycle possible in the clothes washer" and "install a new programmable thermostat."

G. Have students look at the backs of their student booklets. Point out that this water and energy efficient home depicts all the recommendations of ways to save water and energy.

LESSON 6: HOME WATER & ENERGY SURVEY

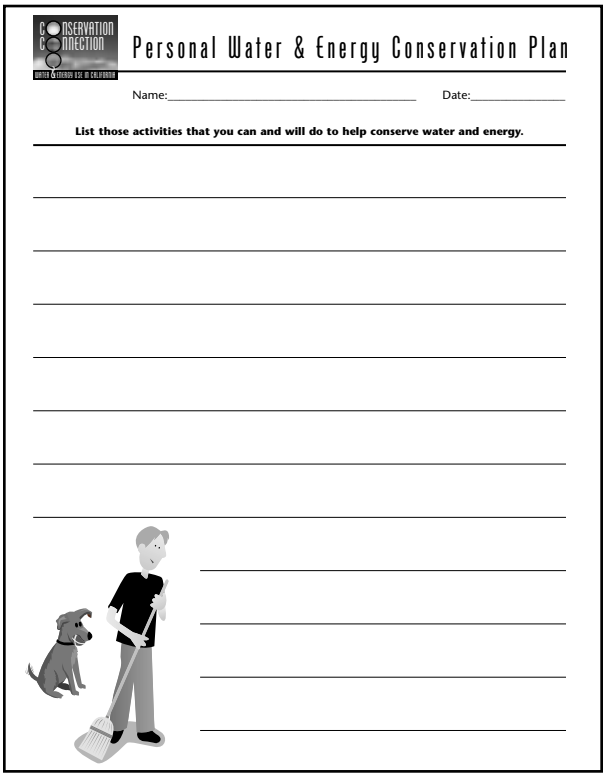
II. Make Personal Conservation Plans

A. Explain that many of the recommendations for conserving water and energy shown on the ***Ways to Save*** sheet are simple practices and habits that anyone can do—like turning off the water while brushing teeth—while others involve more effort and expense.

B. Ask students to look at the various ways to save in the areas where they have items circled. Discuss some of the activities that students can do personally to conserve water or energy—that is, practices and habits that they can do without the help of their families.

C. Distribute a ***Personal Water & Energy Conservation Plan*** to each student or have them make their own. Ask students to list those activities that they can and **will** do to help conserve water and energy. Discuss the activities that students list.

D. Have students illustrate one or more conservation practices on the back of their plans.


Personal Water & Energy Conservation Plan

Name:_____ Date:_____

List those activities that you can and will do to help conserve water and energy.

III. Make Family Conservation Plans

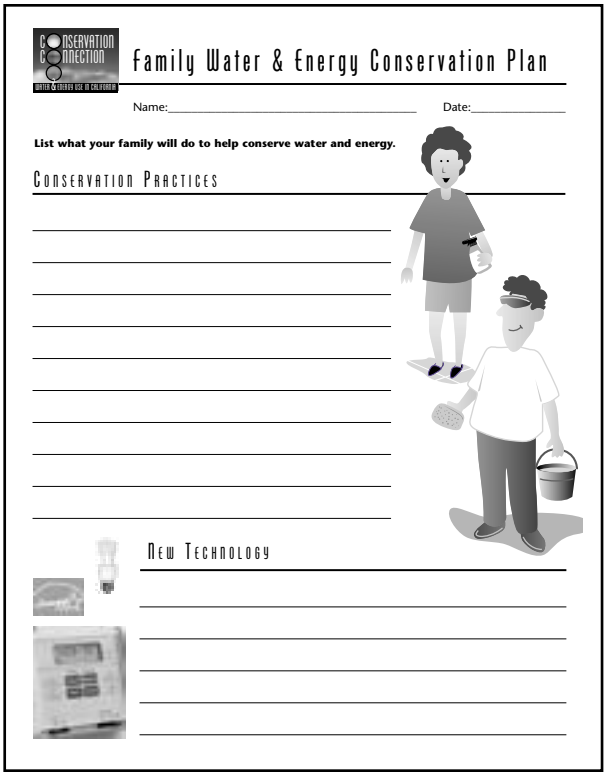
A. Tell students that they are to take home, share, and discuss with their families the ***SUMMARY of Ways to Save Water & Energy at Home***. Encourage students to talk with their families about:

- the importance of conserving water and energy
- the circled items on the *Summary* that indicate areas in which their family can improve as shown by the survey
- what they learned about water and energy use and conservation in each of the areas.

*(**NOTE:** You may also want to photocopy the Water and Energy Efficient Home from the back of the student booklet to send home with students.)*

B. Distribute a ***Family Water & Energy Conservation Plan*** to each student or have them make their own. Tell students to work with their family members to make a list of the ways their family can save water and energy, using the recommendations on the *Ways to Save* sheet.

C. Set a date for the Family Plans to be completed and returned.


Family Water & Energy Conservation Plan

Name:_____ Date:_____

List what your family will do to help conserve water and energy.

Conservation Practices

New Technology

IV. Evaluate Conservation Plans

A. When students bring back their *Family Water & Energy Conservation Plans*, take a tally to see what students' families are planning to do to conserve water and energy.

B. Have students review their Personal Plans and their Family Plans each week. Tell them to put a check by the activities that are being done and to cross off any items that have been completed (for example: *fix leaky faucet*). Have students update and change plans where necessary.

C. Discuss the plans:
1. Why are certain activities not being done?
2. What changes have been easy to make?
3. What changes have been difficult?
4. What else can they do?

Ask students to think about what they can do to see that the conservation practices are followed. For example, if long showers are still being taken, perhaps they could put a timer in the bathroom; if the heat is still being left on at night, perhaps they could put more blankets on the beds.

V. Calculate Savings in Water and Energy

A. Using the information on the sheets *How Much Water Does It Use?* (from Lesson 3) and *How Much Energy Does It Use?* (from Lesson 5), have students calculate:
- How much water and energy their family is saving.
- How much water and energy is being saved by the entire class.

B. Using the costs for water, electricity, and natural gas in your area (determined either from bills or by contacting utilities) have students calculate how much money their families can save per month, per year.

Extension Activities

- **Design a water and energy efficient home**. Have students research and make plans to build and furnish a home that would make efficient use of water and energy.
- **Organize a conservation campaign.** From their surveys, have students determine what areas most need improving. Have students plan how they can help people in their community conserve. For example, they might:
  - develop flyers to hand out
  - fix leaks
  - distribute conservation equipment, such as aerators
  - fix, unclog, or adjust sprinklers so that pavement is not being watered
  - perform draft tests on windows and caulk air leaks.
- **Compare models**. Have students look at and compare the "Energy Guide" on appliances such as refrigerators, clothes washers, clothes dryers, and dishwashers. Why do some models use less energy or water?
- **Conduct solar experiments.** How does window size affect solar heating? What placement of windows provides the most effective solar heating of a building? How does shading windows affect the temperature inside the building? Which keeps a room coolest: drapes, window shades, blinds?
- **Demonstrate insulation.** Gather the following materials: 2 small water glasses, 2 thermometers, ice chest with ice or a refrigerator, cotton balls, small corrugated cardboard box. Fill the glasses with equal amounts of room temperature water. Measure and record the temperatures. Put cotton balls on the bottom of the cardboard box; put one glass inside; then pack the empty space between the glass and the side of the box with cotton balls. Put a thermometer in each glass and place the glasses—one in the box and one not—inside the ice-filled ice chest or refrigerator. Check and record the water temperatures after 5 minutes and 10 minutes.

LESSON 7: SCHOOL WATER & ENERGY

IMPORTANT: *Before students survey the school, and particularly before they try to instigate changes at the school, it is important to get support from your administration. You may also need to talk with maintenance staff to inform them of students' plans and to ask for their help.*

✪ Lesson Overview

Students will:

- conduct a survey of water and energy use at their school
- analyze the *School Water & Energy Survey* to determine areas where conservation could be improved
- review recommendations to save water and energy at school
- develop and implement a school conservation plan
- evaluate their school plan
- conduct and analyze a survey at a community facility

✪ Materials and Preparation

- *School Water & Energy Survey* (4 pages)
  - copy one for each student or each of the 5 groups (as a 4-page foldover on ledger-size paper, if possible)
  - make a transparency and/or a master sheet of each page
- *Ways to Save Water & Energy at School* (5 pages)
  - make a transparency of each page
- *School Water & Energy Conservation Plan*
  - make a transparency and/or a master sheet

✪ Approximate Time Requirement

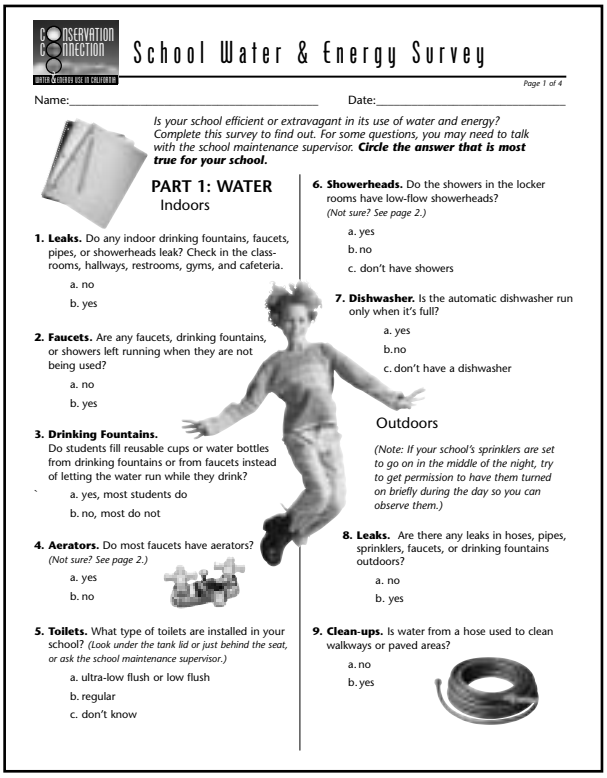
- 1-2 class periods to plan and conduct the school survey with, perhaps, some out of class time
- 1-2 class periods to analyze survey and make conservation plan
- 10-15 minutes periodically to monitor and evaluate plan

✪ Procedures

I. Conduct School Water & Energy Survey

A. Tell students that besides at home, they also can make an impact on water and energy conservation at school. Show on the overhead the ***School Water & Energy Survey.*** Read aloud the information at the top of the survey and point out the following:

- Survey is divided into two parts:
  Part 1: Water
  Part 2: Energy
- Some questions simply require observation to be answered; others require them to do a little research or to talk to maintenance people.
- Tips for some of the items appear at the end of each part on pages 2 and 4.



School Water & Energy Survey

Page 1 of 4

Name:_____ Date:_____

Is your school efficient or extravagant in its use of water and energy? Complete this survey to find out. For some questions, you may need to talk with the school maintenance supervisor. ***Circle the answer that is most true for your school.***

PART 1: WATER
Indoors

1. Leaks. Do any indoor drinking fountains, faucets, pipes, or showerheads leak? Check in the classrooms, hallways, restrooms, gyms, and cafeteria.
a. no
b. yes

2. Faucets. Are any faucets, drinking fountains, or showers left running when they are not being used?
a. no
b. yes

3. Drinking Fountains. Do students fill reusable cups or water bottles from drinking fountains or from faucets instead of letting the water run while they drink?
a. yes, most students do
b. no, most do not

4. Aerators. Do most faucets have aerators? *(Not sure? See page 2.)*
a. yes
b. no

5. Toilets. What type of toilets are installed in your school? *(Look under the tank lid or just behind the seat, or ask the school maintenance supervisor.)*
a. ultra-low flush or low flush
b. regular
c. don't know

6. Showerheads. Do the showers in the locker rooms have low-flow showerheads? *(Not sure? See page 2.)*
a. yes
b. no
c. don't have showers

7. Dishwasher. Is the automatic dishwasher run only when it's full?
a. yes
b. no
c. don't have a dishwasher

Outdoors

(Note: If your school's sprinklers are set to go on in the middle of the night, try to get permission to have them turned on briefly during the day so you can observe them.)

8. Leaks. Are there any leaks in hoses, pipes, sprinklers, faucets, or drinking fountains outdoors?
a. no
b. yes

9. Clean-ups. Is water from a hose used to clean walkways or paved areas?
a. no
b. yes

B. Divide the class into **five** groups to cover the various areas on the survey:

1. Water – Indoors *(Items 1-7)*
2. Water – Outdoors *(Items 8-16)*
3. Energy – Heating and Cooling *(Items 17-25)*
4. Energy – Lights and Appliances *(Items 26-30)*
5. Energy – Cafeteria *(Items 31-34)*

C. Distribute copies of the survey and have the groups meet to determine what needs to be done and how they will get the answers to each question.

D. Set a date for completion.

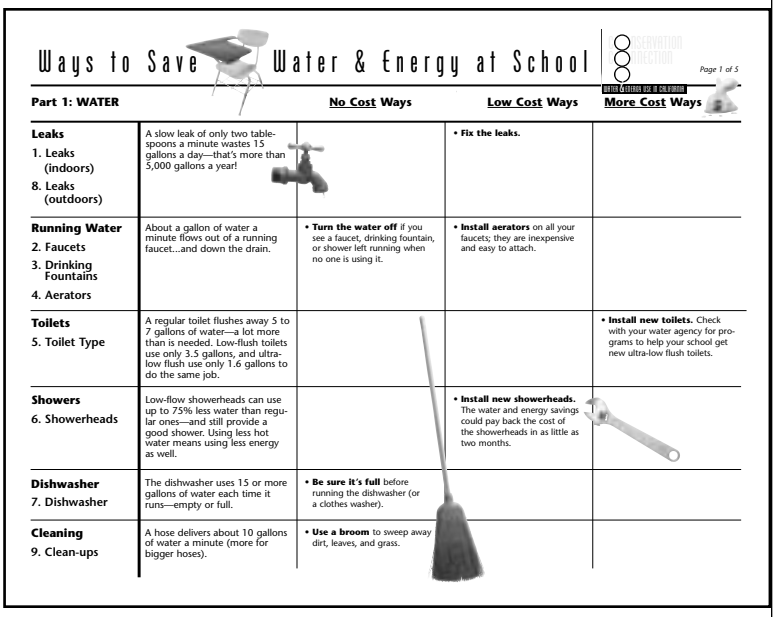
II. Analyze School Water & Energy Survey

A. Discuss findings from the *School Water & Energy Survey*. Have each group share the results from their section of the survey and mark all the responses on the projected transparency and/or master sheet. Ask:

1. Are there any surprises?
2. Did you find any areas that you think need improvement?

B. After the responses are recorded on the transparency or master sheet, circle the number of any item that has a **b** response. *(**NOTE:** For #16 "Watering Amount," circle the item for **any** response except "e.")* Tell students that these answers indicate a potential "waster" activity.

C. Explain that for every item there are recommendations for "ways to save" water or energy. Project the transparencies of ***Ways to Save Water & Energy at School.*** Explain that the second column provides a little information about why it is important to save water or energy in that area *(for example, leaks)*; the other columns describe what actions could be taken in schools to conserve water and energy. Point out that there are various levels of cost for implementing these recommendations.



Ways to Save Water & Energy at School

Page 1 of 5

Part 1: WATER		No Cost Ways	Low Cost Ways	More Cost Ways
Leaks 1. Leaks (indoors) 8. Leaks (outdoors)	A slow leak of only two tablespoons a minute wastes 15 gallons a day—that's more than 5,000 gallons a year!		• **Fix the leaks.**	
Running Water 2. Faucets 3. Drinking Fountains 4. Aerators	About a gallon of water a minute flows out of a running faucet...and down the drain.	• **Turn the water off** if you see a faucet, drinking fountain, or shower left running when no one is using it.	• **Install aerators** on all your faucets; they are inexpensive and easy to attach.	
Toilets 5. Toilet Type	A regular toilet flushes away 5 to 7 gallons of water—a lot more than is needed. Low-flush toilets use only 3.5 gallons, and ultra-low flush use only 1.6 gallons to do the same job.			• **Install new toilets.** Check with your water agency for programs to help your school get new ultra-low flush toilets.
Showers 6. Showerheads	Low-flow showerheads can use up to 75% less water than regular ones—and still provide a good shower. Using less hot water means using less energy as well.		• **Install new showerheads.** The water and energy savings could pay back the cost of the showerheads in as little as two months.	
Dishwasher 7. Dishwasher	The dishwasher uses 15 or more gallons of water each time it runs—empty or full.	• **Be sure it's full** before running the dishwasher (or a clothes washer).		
Cleaning 9. Clean-ups	A hose delivers about 10 gallons of water a minute (more for bigger hoses).	• **Use a broom** to sweep away dirt, leaves, and grass.		

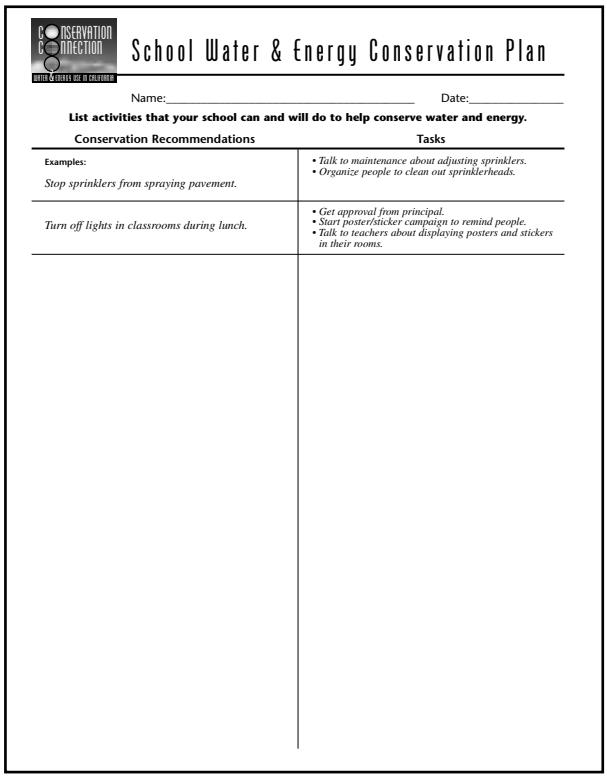
D. Discuss the recommendations for each item needing improvement, that is, the items on the survey with a **b** response. Ask students if they have suggestions for conserving water and energy other than those listed.

E. If you have circled #16 on the survey (if your school has a lawn, this item should be circled), point out to students that the recommendation is perform the sprinkler test to see if your school needs to adjust sprinkling times. Have students perform the sprinkler test (page 3 on the *Ways to Save* sheet), checking either all lawn areas or just a portion of the school lawn to get the idea.

III. Develop a School Water & Energy Conservation Plan

A. Have students as a class decide what changes at their school they would like to work on. Suggest that they focus on only one or two areas (e.g., for water—leaks or overspraying sprinklers; for energy—lights on in empty rooms or equipment left on all night).

B. Project the ***School Water & Energy Conservation Plan***. Discuss the examples shown on the plan. Point out to students that it is important to find out and go through the proper "chain of command" to make some changes; for example, just asking the maintenance crew to do something differently will not work if the maintenance department is following a district policy.



School Water & Energy Conservation Plan

Name:_____ Date:_____

List activities that your school can and will do to help conserve water and energy.

Conservation Recommendations	Tasks
Examples: *Stop sprinklers from spraying pavement.*	• *Talk to maintenance about adjusting sprinklers.* • *Organize people to clean out sprinklerheads.*
Turn off lights in classrooms during lunch.	• *Get approval from principal.* • *Start poster/sticker campaign to remind people.* • *Talk to teachers about displaying posters and stickers in their rooms.*

C. For the area(s) on which they've decided to focus, have students start planning how to get changes made. Either:

- work together as a class
  or
- divide the class into groups to plan how they would go about improving conservation in the chosen area and what tasks need to be done. Have each group share their ideas with the class and then vote on which ideas to put into action.

Emphasize to students that for any presentations they make—to the principal, the school board, the maintenance supervisor—it is important for them to be prepared with data, costs, specific plans, and recommendations.

IV. Monitor and Evaluate School Conservation Plan

A. Monitor the progress of the *School Water & Energy Conservation Plan*. Discuss:
   - what has and has not been accomplished
   - why certain tasks have yet to be done
   - what tasks need to be added
   - when tasks will be completed.

   Make revisions to the plan and continue to monitor the progress.

B. As a class, have students evaluate the success of the plan they made to conserve water and energy at their school. If possible, see if they can compare water or energy usage before and after their plan, either by checking bills or by checking with the district office.

V. Survey Community Facility

A. Locate one or more community facilities *(for example, parks, churches, community centers, local businesses)* that are willing to have students survey their water and energy use.

B. Have students decide whether the home or school survey is more appropriate, or whether they should develop another survey specifically for that site.

C. Have students conduct and analyze the survey to determine where water and energy is being wasted at that facility.

D. From the survey results, have students compile specific recommendations for conserving water and energy at that facility and present the results. If appropriate, have students volunteer to help institute some of the changes.

Extension Activities

- **Compare sunlight and electric light.** Cover the windows and turn on the lights necessary to work comfortably. Add up the electrical usage to keep these lights on throughout the day. Now uncover the windows and see how many lights can be turned off. Compare the usage. Also, in warm weather, compare the temperature with windows covered and uncovered and consider air conditioning load increase.
- **Write proposals to make improvements**. If students have found that their school needs new equipment to help conserve water or energy, have them write proposals to get the change done—both approval to make the change and money to fund the change.
- **Go on patrol.** Ask students to observe in the community where they see water and energy being wasted, for example, lights left on in office buildings all night, parks being watered in the rain. Keep a list and find out who to talk to change the "waster" activity.
- **Examine heating and/or air conditioning systems.** Ask the school's custodian or your district's energy manager to take your students on a tour of your school's heating system and, if your school has it, air conditioning system. Have students find out how the electric and/or gas meter works, how the air gets heated or cooled, how the heated or cooled air gets into the rooms, what it costs each month to heat or cool the school.

APPENDICES

PAGE

MASTERS - WORKSHEETS & INFORMATION SHEETS

- *Personal Water & Energy Use* (2 pages)
- *How Much Water Does It Use?*
- *Energy Source Comparison*
- *How Much Energy Does It Use?*
- *Summary of Ways to Save Water & Energy at Home* (2 pages)
- *Personal Water & Energy Conservation Plan*
- *Family Water & Energy Conservation Plan*
- *School Water & Energy Conservation Plan*
- *Assessment* (2 pages)

Personal Water & Energy Use

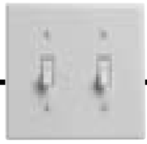
Name:_____ Date:_____

Water Use	Time	Gallons Used
Example: flush toilet	7:00 a.m.	

TOTAL _____ **gallons**

Personal Water & Energy Use

Name:______________________________________ Date:______________



Energy Use	Time	Kilowatt Hours	OR BTU Used
Example: alarm clock	6:30 a.m.		

TOTAL _______ **kWh** _______ **BTU**

How Much Water Does It

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

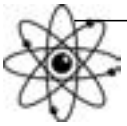
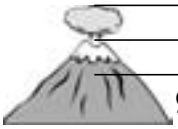
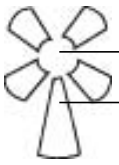
Water Use	Estimated Regular Amount	Estimated Water Conserving Amount
Toilet Flush	6 gallons	3.5 gallons for low flush 1.6 gallons for ultra-low flush
Shower	4 gallons per minute	2.2 gallons per minute with low-flow showerhead
Bath	30 gallons bathtub full	15 gallons bathtub half full
Brush Teeth	5 gallons water running	1/2 gallon with water turned off
Wash Hands	2 gallons water running	1/2 gallon with sink half full of water
Wash Dishes by Hand	30 gallons water running	5 gallons with sink full of water
Automatic Dishwasher	15 gallons regular cycle	10 gallons short cycle
Clothes Washer	30 gallons regular cycle	20 gallons short cycle
Water Yard	250 gallons large yard	180 gallons small yard
Faucet	3.5 gallons per minute	2 gallons per minute with aerators

Energy Source Comparison

Name:_____ Date:_____

What are some advantages and disadvantages of each of our energy sources?

Think about: **supply** **cost** **environmental effects**

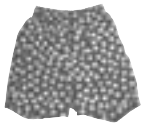
Energy Source	Advantages	Disadvantages
 fossil fuels		
 hydropower		
 nuclear power		
 biomass		
 geothermal		
 wind power		
 solar		

How Much Energy Does It

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

Appliance	Estimated Energy Use
Air Conditioner – Room	1.3 kWh per hour
Air Conditioner – Central	3.0 kWh per hour
Blender	0.4 kWh per hour
Cassette Player	0.01 kWh per hour
CD Player	0.01 kWh per hour
Clock	0.05 kWh per day
Clothes Dryer	3.0 kWh per load OR 18,000 BTU per hour
Clothes Washer	0.25 kWh per load
Coffee Maker	0.20 kWh per pot
Computer	0.12 kWh per hour
Dishwasher	1.5 kWh per load
Electric Blanket	0.75 kWh per night
Fan	0.17 kWh per hour
Frying Pan	1.20 kWh per hour
Furnace	15.0 kWh per hour OR 100,000 BTU per hour
Hair Dryer	1.0 kWh per hour
Heater – Portable	1.5 kWh per hour
Iron	1.0 kWh per hour
Microwave	1.5 kWh per hour
Oven	3.0 kWh per hour OR 18,000 BTU per hour
Radio	0.10 kWh per hour
Range Burner	1.5 kWh per hour OR 9,000 BTU per hour
Refrigerator	5.0 kWh per hour
Television	0.20 kWh per hour
Toaster	0.10 kWh per use
Toaster Oven	0.75 kWh per hour
Vacuum Cleaner	0.75 kWh per hour
VCR	0.02 kWh per hour
Water Heater	13.0 kWh per day OR 36,000 BTU per hour
100-Watt Incandescent Light Bulb	0.10 kWh per hour
27-Watt Fluorescent Light Bulb	0.03 kWh per hour

SUMMARY of Ways to Save Water & Energy at

Part 1: WATER	No Cost Ways	Low Cost Ways	Most Cost Ways
1, 2 Toilets	• Use a wastebasket instead of flushing trash down the toilet.	• Install a displacement device in the toilet tank.	• Get new low-flush toilets. 
3, 4 Showers	• Take shorter showers and shallower baths.	• Install a new low-flow showerhead.	
5, 6 Faucets	• Turn the water off while brushing your teeth, shaving, washing dishes, etc.	• Install aerators on all your faucets.	
7, 8 Dishwasher and Clothes Washer	• Wash full loads of dishes and clothes. • Use the shortest cycles. • Use cold water in clothes washer whenever possible to save energy. • Air dry dishes in the dishwasher by opening the door slightly after the final rinse to save energy.		• Replace old appliances with Energy Star-rated appliances.
9, 10, 11 Lawn and Garden	• Trim around, clean out, adjust, and repair sprinklers so they direct water only onto the lawn. • Set a timer to remind you to turn sprinklers off. • Water early in the morning. (Avoid peak water and energy use hours of noon to 8 p.m.) • Water only when necessary. • Water slowly to reduce runoff. • Build basins around plants. • Use mulch around trees, shrubs, and plants. • Adjust watering schedules with weather. 	• Replace broken sprinklerheads. • Aerate your lawn so that water soaks in. • Use a shut-off nozzle on hose. • Install automatic irrigation timers.	• Update your irrigation system. • Plant low-water use lawns and plants. • Replace lawns with drought-tolerant ground cover and shrubs. 
12, 13 Outdoor Cleaning	• Use a broom instead of the hose. • Use a bucket of water not a running hose to wash your car.	• Use a shut-off nozzle on the hose.	
14 Pool	• Lower the water temperature to reduce evaporation and to save energy.		• Use a pool cover.
15 Leaks		• Fix the leak.	• Call a plumber.

SUMMARY of Ways to Save Water & Energy at

Part 2: ENERGY	No Cost Ways	Low Cost Ways	Most Cost Ways
16, 17, 18 Heating	• Wear more layers of clothes. • Keep the thermostat at 68 degrees or lower during the day and 58 degrees or lower at night.	• Install a programmable thermostat. • Change your furnace filter every month or two. • Have your furnace serviced.	• Replace an old furnace.
19, 20 Cooling	• Set the thermostat no lower than 78 degrees when you're home and 85 degrees when you're away. • Close shades or curtains over sunny windows. • Avoid using heat-producing appliances during the warmest time of the day.	• Use floor and ceiling fans. • Check ducts for breaks or leaks. • Shade air conditioning unit from direct sunlight.	• Plant deciduous shade trees on the south and west sides of the house. • Add awnings or shades over outside sunny windows. • Install roof vents or an attic fan. • Add a whole house fan.
21 Insulation			• Add insulation in outside walls and ceiling.
22, 23 Windows and Doors	• Keep windows and doors closed when you have the heater or air conditioner on.	• Weather strip outside doors and caulk window frames and any cracks, holes, or openings through which air can flow.	
24 Water Heater	• Turn down the temperature to 130 degrees or less, or to the "conservation" setting.	• Wrap insulation around water heater (especially an old one) and around the water pipes leading from the heater.	
25, 26, 27 Lights and Small Appliances	• Turn off lights, TVs, stereos, etc. that aren't being used. • Use clock timers to shut off TVs and stereos automatically. • Unplug charging units. • Change to lower-wattage bulbs. • Clean bulbs and fixtures.	• Use compact fluorescent bulbs where possible. • Install clock timers or motion sensors to turn lights off automatically. • Use a microwave or a small electric oven for small amounts.	
28, 30 Refrigerator	• Open and close the refrigerator door quickly. • Reduce number of times you open the refrigerator. • Clean the coils of your refrigerator.		• Replace old refrigerator with low energy-use refrigerator. Look for Energy-Star appliances.
29, 30 Clothes Dryer	• Dry only full loads of laundry. • Set dryer to auto-dry rather than a timed cycle.		• Replace old dryer with low energy-use dryer. Look for Energy-Star appliances.
31 Carpooling	• Carpool whenever possible. • Walk or bicycle when possible.	• Take public transportation. • Keep your car's engine tuned and tires properly inflated.	• Buy a car that gets high gas mileage, such as a hybrid that uses gasoline and electricity.

Personal Water & Energy Conservation

Name:_____ Date:_____

List those activities that you can and will do to help conserve water and energy.

Family Water & Energy Conservation

Name:_____ Date:_____

List what your family will do to help conserve water and energy

Conservation Practices

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

New Technology

_____

_____

_____

_____

_____

School Water & Energy Conservation

Name:_____ Date:_____

List activities that your school can and will do to help conserve water and energy.

Conservation Recommendations	Tasks
Examples: *Stop sprinklers from spraying pavement.*	• *Talk to maintenance about adjusting sprinklers.* • *Organize people to clean out sprinklerheads.*
Turn off lights in classrooms during lunch.	• *Get approval from principal.* • *Start poster/sticker campaign to remind people.* • *Talk to teachers about displaying posters and stickers in their rooms.*

Assessment

Name:_____ Date:_____

Circle the letter of the answer that best completes each sentence.

1. Surface water refers to:

a. the ocean

b. water in lakes, streams, rivers, and oceans

c. water in aqueducts and reservoirs

2. Groundwater refers to:

a. all the water on top of the ground

b. all the water under the ground

c. the water in wells

3. In California, almost half of our water supply is used:

a. for crops and farm animals

b. in homes and businesses

c. for public services

4. Aqueducts are used to:

a. store water

b. prevent flooding

c. transport water

5. California's population is:

a. increasing

b. staying about the same

c. decreasing

6. In California, our supply of water:

a. is more than we need

b. comes partly from water from other states

c. is mainly in the southern part of the state

7. Recycled water can be used:

a. only for irrigation

b. only if fresh water is not available

c. for all purposes except drinking

8. The main reason we don't use desalination more is:

a. the Pacific Ocean is too salty

b. it is expensive

c. both a and b

9. We can conserve water:

a. through improved technology

b. by using non-wasteful practices

c. both a and b

10. In the United States, and in California, most of the energy we use comes from:

a. hydropower

b. nuclear power

c. fossil fuels

11. Hydropower is a:

a. renewable energy source

b. nonrenewable energy source

c. polluting energy source

12. The fuel for biomass is:

a. uranium

b. hydrogen

c. trash

Assessment

13. One reason that wind doesn't supply more of our energy is:

a. it's a nonrenewable source

b. wind machines are too expensive

c. it is not reliable

14. Solar cells are used to:

a. make electricity

b. heat water

c. power fuel cells

15. In California, our supply of energy:

a. comes partly from other states

b. always meets our demand

c. is not a problem

16. Appliances today are generally:

a. more efficient than in the past

b. less efficient than in the past

c. bigger than those in the past

17. We can save energy in buildings by using:

a. incandescent light bulbs

b. programmable thermostats

c. more appliances with "stand-by" modes

18. Each person today uses more energy than people in the past because:

a. each appliance uses more energy

b. we have more appliances that use energy

c. both a and b

19. In the future, we may need to depend more on:

a. renewable energy sources

b. nonrenewable energy sources

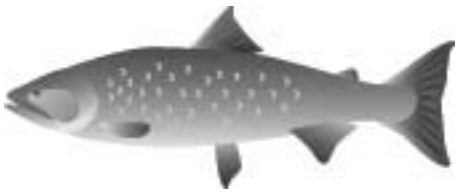
c. fossil fuels

20. Conserving energy means that we will:

a. save money

b. protect the environment

c. both a and b



MASTERS - SURVEYS AND RECOMMENDATIONS

- *Home Water & Energy Survey* (4 pages)
- *Ways to Save Water & Energy at Home* (5 pages)
- *School Water & Energy Survey* (4 pages)
- *Ways to Save Water & Energy at School* (5 pages)

Home Water & Energy Survey

Name:_____ Date:_____

Are your family "savers" or "wasters"? This survey about your family's use of energy and water will help you find out. ***Circle the answer that is most true for you.***

PART 1: WATER
Indoors

1. Toilet Type. What type of toilet(s) do you have at home? *(Not sure? See page 2.)*

a. low-flush or ultra-low-flush

b. regular

2. Toilet Trash. Is trash sometimes flushed down toilets?

a. no

b. yes

3. Showers and Baths. Do people spend 10 minutes or less in the shower?

a. yes, most of the time

b. no, some people take long showers

4. Showerheads. Do you have low-flow showerheads? *(Not sure? See page 2.)*

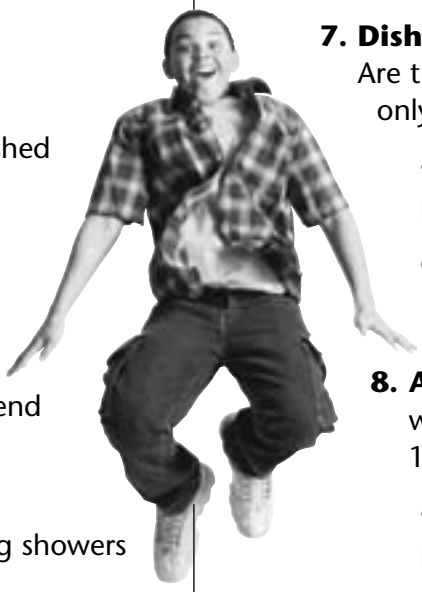
a. yes

b. no

5. Faucets. Do people leave the water running while washing hands, brushing teeth, shaving, doing dishes, or cleaning fruits and vegetables?

a. no

b. yes, some people leave the water running



6. Aerators. Do all faucets in the kitchen and bathroom(s) have aerators? *(What's an aerator? See page 2.)*

a. yes

b. no

7. Dishwasher and Clothes Washer. Are the dishwasher and clothes washer used only when full?

a. always full

b. sometimes full

c. never full

8. Age of Appliances. Is your dishwasher or clothes washer more than 15 years old?

a. no

b. yes

c. don't know

d. don't have either appliance

Outdoors

9. Sprinklers. If you use sprinklers—either attached to the hose or built in—does a lot of pavement get wet from either overspray or runoff?

a. no, never

b. yes, always

c. yes, sometimes

d. don't use sprinklers

10. Watering Time. When does the lawn or garden get watered?

a. mornings

b. mid-day

c. evenings

d. don't have a lawn or garden

11. Seasonal Watering. Is the time spent watering the lawn changed depending on the season (that is, fewer minutes in fall and winter, more in spring and summer)?

a. yes

b. no

c. don't know

d. don't have a lawn

12. Clean-ups. Is the hose used to clean driveways, patios, sidewalks, or other pavement areas?

a. never or rarely

b. often or sometimes

13. Car Washing. Do you turn off the hose while soaping the car before rinsing it?

a. yes, always

b. no, never

c. sometimes

d. don't wash car at home

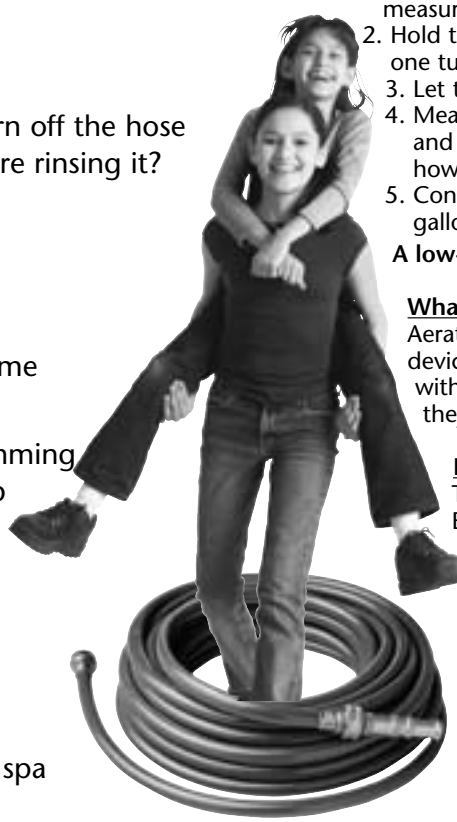
14. Pool or Spa. Is your swimming pool and/or spa or hot tub covered at night and during cool weather?

a. yes, always

b. no, never

c. sometimes

d. don't have a pool or spa



Indoors and Outdoors

15. Water Leaks. Do any your faucets, pipes, or toilets leak? *(To learn how to check for leaks, see below.)*

a. no

b. yes

Helpful Tips for the Water Survey

Toilet Type

To find out what type of toilet you have, first look under the tank lid or just behind the seat. If the toilet type or gallons per flush is not indicated, here's how to find out:

1. Get a pitcher or container that shows measurement.
2. Turn off the incoming water behind the toilet.
3. Mark the water level in the tank with a grease pencil or with tape.
4. Flush the toilet.
5. Use the pitcher to refill the tank (not the bowl) to the mark you made, noting how much water is needed (16 cups = 4 quarts = 1 gallon).
6. Add 1/2 gallon to the total (the amount that fills the toilet bowl).
7. Now compare your figure to the numbers below to determine which type of toilet you have:
   5 to 7 gallons per flush = regular toilet
   3.5 gallons per flush = low flush toilet
   1.6 gallons per flush = ultra low flush toilet

Showerheads

Here's how to find out if you have a low-flow showerhead.

1. Get a bucket, a watch with a second hand, and a measuring cup.
2. Hold the bucket under the showerhead and have someone turn on the water at full pressure.
3. Let the water run into the bucket for 15 seconds.
4. Measure how many cups of water are in the bucket and multiply the number of cups by 4 (to figure out how many cups per minute).
5. Convert the number of cups to gallons (16 cups in a gallon) to determine how many gallons per minute.

A low-flow showerhead will equal 2.5 gallons or less.

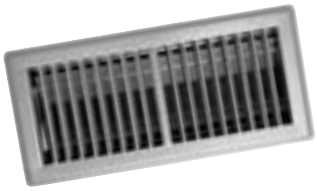
What's an Aerator?

Aerators mix air with the water. If your faucets have little devices attached where the water comes out—devices with a little screen that makes the water bubbly—then they have aerators.

Leaks

There are several ways that you can check for leaks. Before doing any of them, turn off all faucets and make sure no one is using any water.

- Find your water meter and watch the dial or the small, triangular flow indicator for 5 to 10 minutes. If the meter moves, you've got a leak.
- Look at all faucets and pipes, inside and outside your home: Are any dripping? Are there any damp spots underneath them?
- Put a few drops of food coloring in the tank at the back of the toilet; wait a few minutes to see if any of the color appears in the bowl. If so, you have a toilet leak.



PART 2: ENERGY
Heating and Cooling

16. Heater Thermostat. What temperature do you set your heater thermostat in winter?

a. 68 degrees or lower
b. 69 degrees or higher
c. don't know
d. no heating system or no thermostat

17. Nighttime Temperature. Do you turn down your heater thermostat at night when people go to bed?

a. yes
b. no
c. don't know
d. no thermostat

18. Furnace Maintenance. Do you have your furnace serviced every year if you have a gas or electric furnace or heater?

a. yes
b. no
c. don't know
d. no furnace or heater

19. Air Conditioner Thermostat. What temperature do you set your air conditioner thermostat in the summer?

a. 78 degrees or higher
b. 77 degrees or lower
c. don't know
d. no air conditioner or no thermostat

20. Window Shades. Are window shades or curtains used to block out sun in warm weather?

a. yes
b. no

21. Insulation. Does your home have insulation in the ceiling and walls to keep heat in during cold weather and out during hot weather?

a. yes, both ceiling and walls are insulated
b. no
c. can't tell

22. Weather Stripping. Does air leak in or out of windows or doors even when they are closed?
(Not sure? See page 4 for the "draftometer" test.)

a. no
b. yes

23. Windows and Doors. Are windows and outside doors kept closed when the heater or air conditioner is on?

a. yes, most of the time
b. no, not usually

24. Water Heater Temperature. Is your water heater temperature set at 130 degrees or lower, or at the *conservation, medium,* or *low* settings?

a. yes
b. no
c. can't tell
d. no water heater or not accessible

Lights and Appliances

25. Light Bulbs. Do you have compact fluorescent light bulbs or fluorescent light tubes in most of your home? *(What's fluorescent lighting? See below.)*

a. yes

b. no

26. Lights and Appliances. Are lights, televisions, stereos, and other electric appliances turned off when they're not being used?

a. yes, most of the time

b. no, often they are left on

27. Cooking. Do you use a microwave or "toaster oven" for small meals or snacks?

a. yes

b. no

28. Refrigerator. Are the refrigerator and freezer doors opened and closed quickly rather than left standing open?

a. yes

b. no

29. Clothes Dryer. Is the clothes dryer used only for full loads?

a. yes

b. no

30. Age of Major Appliances. Do you have any "old" (15 years or more) major appliances: *furnace, air conditioner, water heater, refrigerator?*

a. no

b. yes

c. don't know

Transportation

31. Carpooling. Does anyone in your family regularly carpool or use public transportation?

a. yes

b. no

Helpful Tips for the Home Energy Survey

Draftometer Test

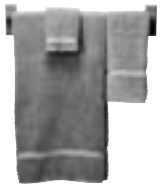
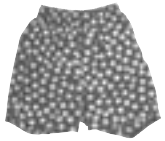
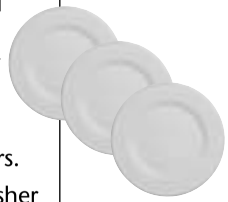
To check windows and doors for leaks, conduct the following test.

1. Cut a piece of thin, plastic food-wrap about 5 inches wide and 10 inches long.
2. Tape the short edge of the plastic along the edge of a pencil.
3. Hold this "draftometer" near the edges of doors and win-dows. If the plastic moves, then air is leaking in or out.

What's Fluorescent Lighting?

Fluorescent light bulbs will likely be either tubes or oddly shaped bulbs, both of which stay cool, as opposed to round incandescent bulbs, which get very hot.

Ways to Save Water & Energy at Home

Part 1: WATER		No Cost Ways	Low Cost Ways	Most Cost Ways
Toilets 1. Toilet Type 2. Toilet Trash	Toilets account for the most use of water within the home, so saving even a little with each flush adds up to a lot.	• **Use a wastebasket.** Throw trash in a wastebasket; don't flush it down the toilet. Flush the toilet only when necessary.	• **Install a displacement device.** If you have a regular toilet—not a low-flush model—put a toilet dam in the tank or simply a plastic bottle filled with water to reduce the amount of water used with each flush. *(Do not use bricks since they can disintegrate and the grit can harm the toilet.)*	• **Get new toilets.** Consider replacing old toilets with ultra low flush models. Check with your water agency for rebates or giveaways. 
Showers 3. Showers and Baths 4. Showerheads	Regular showers use about 4 gallons of water per minute and a bath can use up to 30 gallons. And all that water has to be heated, which uses energy as well.	• **Take shorter showers and shallower baths.** You can also turn the water off while soaping up or shampooing hair and then turn it back on to rinse. Some showerheads have an *on/off* lever or button.	• **Install a new showerhead.** A low-flow showerhead can use up to 75% less water while still providing a firm spray. 	
Faucets 5. Faucets 6. Aerators	About a gallon of water a minute flows out of a running faucet...and down the drain.	• **Turn the water off** while brushing your teeth or soaping up your hands or face and then turn it back on to rinse. For shaving, put a little water in the basin. And wash dishes and produce in a sink of water rather than under a running faucet.	• **Install aerators** on all your faucets; they are inexpensive and easy to attach. 	
Appliances 7. Dishwasher and Clothes Washer 8. Age of Appliances	Dishwashers and clothes washers use both water and energy. 	• **Wash full loads** of dishes and clothes. The machines use the same amount of water whether full or almost empty. • **Use the shortest cycles** on clothes washers and dishwashers. • **Use cold water** in clothes washer whenever possible to save energy. • **Air dry** dishes in the dishwasher by opening the door slightly after the final rinse to save energy.		• **Replace old appliances.** Energy Star-rated clothes washers and dishwashers use significantly less water—up to 40% less—than older models. Check with your water agency for rebates.

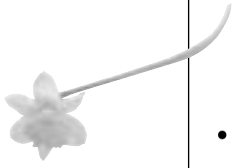
Ways to Save Water & Energy at Home

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

Lawn and Garden Watering

9. Sprinklers
10. Watering Time
11. Seasonal Watering

Lawn and garden watering along with other outdoor water uses account for almost half of all home water use.

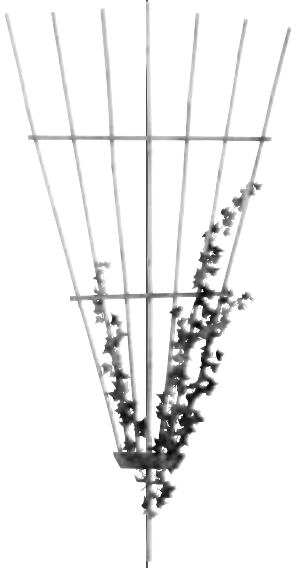


No Cost Ways

- **Adjust your sprinklers** if they direct water onto the pavement instead of on the lawn.
- **Trim around sprinklerheads,** clean out any clogged sprinklers, and repair broken sprinklerheads.
- **Set a timer** so that you don't forget to turn the sprinklers off.
- **Water early in the morning** when temperatures are cooler and the air is still. Avoid peak water and energy use hours of noon to 8 p.m.
- **Water only when necessary.** Check by stepping on the grass; if it springs back, it doesn't need water.
- **Water slowly** to reduce runoff and to allow the water to soak in deeply. If necessary, water for 5 minutes, turn the water off for 10 minutes, then water for another 5 minutes.
- **Build basins.** Creating a furrow of soil around plants will help get the water to the roots and avoid runoff.
- **Use mulch.** Putting chunks of bark, peat moss, or wood chips over the soil around trees, shrubs, and plants will reduce evaporation.
- **Adjust watering schedules** with weather and seasons. Water less during cool months, sometimes not at all in winter.

Low Cost Ways

- **Replace broken sprinklerheads.**
- **Aerate your lawn** so that the water soaks in. Aerators are usually available from equipment rental agencies.
- **Use a hose-end nozzle** that shuts the water off as you move from plant to plant.
- **Install automatic irrigation timers.** Be sure to reset them seasonally.



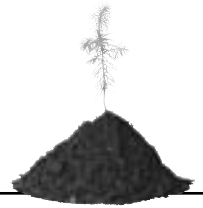
More Cost Ways

- **Update your irrigation system.** Install drip irrigation, soaker hoses, or more efficient sprinklers where needed.
- **Xeriscape.** Replace water-guzzling plants with low-water users.
- **Reduce water-guzzling lawns.** Replace them with drought-tolerant ground cover and shrubs.

Ways to Save Water & Energy at Home

		No Cost Ways	Low Cost Ways	More Cost Ways
Outdoor Cleaning 12. Clean-ups 13. Car Washing	A hose delivers about 10 gallons a minute (more for bigger hoses). 	• **Use a broom** to sweep away dirt, leaves, and grass from pavement areas. Save the water for washing. • **Use a bucket** full of water to wash your car, turning the hose on only to rinse.	• **Use a hose-end nozzle** that shuts the water off when you don't need it. 	
Pool 14. Pool or Spa	An uncovered pool loses from 900 to 3,000 gallons of water per month, depending on size, weather, and water temperature. A cover cuts down on evaporation and heat loss—saving water and reducing energy costs up to 90 percent.	• **Lower the water temperature.** If your pool is heated, you can reduce water loss through evaporation by turning down the thermostat as warm water evaporates faster than cool water. You'll save energy, too.		• **Use a pool cover.** Buy an insulated cover and keep the pool or spa covered whenever it is not being used.
Leaks 15. Water Leaks 	Even a slow leak of only two tablespoons a minute wastes 15 gallons a day—that's more than 5,000 gallons a year. A leaky toilet—one that keeps running—can waste several gallons a minute!		• **Fix the leak.** A dripping faucet may need a new washer. A leaking toilet may need a new flapper. A leaky pipe may need some plumber's tape.	• **Call a plumber,** if necessary, if a faucet is broken, a pipe is corroded, or a toilet needs to be replaced. 

Ways to Save Water & Energy at Home

Part 2: ENERGY		No Cost Ways	Low Cost Ways	More Cost Ways
Heating 16. Heater Thermostat 17. Nighttime Temperature 18. Furnace Maintenance	Heating is the biggest use of energy in the home. Estimates are that you can save 2% on your heating costs for every degree you turn your thermostat down.	• **Wear more clothes.** Instead of turning up the heat, put on a sweater or sweatshirt and socks. • **Turn down the thermostat.** Keep the thermostat at 68 degrees or lower during the day when you're home. Turn it down to 58 degrees or lower when you go to bed at night.	• **Install a new thermostat** – one that you can program to change the temperature setting at certain times. • **Change your furnace filter.** Clean or change the air filter on your furnace every month or two during the heating season. • **Have your furnace serviced.** Call a heating technician to have your gas or electric furnace tested, cleaned, and adjusted every year.	• **Replace an old furnace.** New furnaces are usually 30% more energy efficient and less costly to operate than old ones. 
Cooling 19. Air Conditioner Thermostat 20. Window Shades	Air conditioners consume huge amounts of electricity, most of it during "peak" mid-day hours when utility companies are running at full capacity.	• **Turn up the thermostat.** Set the thermostat no lower than 78 degrees when you're home and 85 degrees or higher while you are away from home. • **Close shades or curtains** over sunny windows to block heat from sunlight. • **Avoid using heat-producing appliances** (e.g., stove, clothes dryer, dishwasher) during the 	• **Use fans.** Floor fans help circulate the air and can be placed to exhaust hot air. Ceiling fans move air across your body to make you feel cooler. A fan uses about 1/10th the energy of an air conditioner. • **Check ducts.** Broken or leaking ducts account for a lot of lost energy. Leaks can be repaired with special tape. • **Shade air conditioning unit** from direct sunlight and make sure	• **Plant trees.** Deciduous shade trees near the house on the south and west sides can reduce the temperature in the house by up to 20 degrees. • **Add awnings** or shades over outside sunny windows. • **Install roof vents** or an attic fan to exhaust trapped heat. • **Add a whole house fan,** which forces hot air out through the attic vents and draws cooler air in through windows during evenings and mornings.
Insulation 21. Insulation	Insulation provides a barrier around the house. Ceiling insulation should be R-30+; at least R-13 is recommended for walls. The greater the "R" factor, the greater the insulating value.			• **Add insulation** in the outside walls and in the ceiling to slow or stop heat transfer in both summer and winter.

Ways to Save Water & Energy at Home

		No Cost Ways	Low Cost Ways	More Cost Ways
Windows and Doors 22. Weather-stripping 23. Windows and Doors	Nearly half of all the energy used in our homes escapes through windows and doors, including through cracks and other leaks.	• **Keep windows and doors** closed when you have either the heater or air conditioner on.	• **Weather strip and caulk.** Put weather stripping around window frames and outside doors. Use caulking to seal any cracks, holes, or openings around electric, plumbing, and lighting fixtures through which air can flow.	
Water Heater 24. Water Heater Temperature	The water heater is the second largest energy user in the home.	• **Turn down the temperature.** Set the temperature at 130 degrees or less, or at the "conservation" or "medium" setting.	• **Wrap insulation** around water heater (especially an old one) and around the water pipes leading from the heater.	
Lights and Small Appliances 25. Light Bulbs 26. Lights and Appliances 27. Cooking	Turning off unused lights, televisions, stereos, and other appliances could save up to $200 a year in energy costs. 	• **Turn it off.** Don't light an empty room or entertain it with music. Use natural light when possible. Use clock timers to shut off TVs and stereos automatically. Unplug charging units. • **Change to the lowest-wattage bulbs** that you need when replacing bulbs. • **Clean bulbs and fixtures.** Dust your light bulbs now and then as clean bulbs use less energy.	• **Use compact fluorescent bulbs where possible.** These bulbs last about 10 times longer than incandescent bulbs and use about 1/4th the energy.  • **Install clock timers or motion sensors** to turn lights off automatically. • **Use a microwave or a small electric oven** for small amounts. They generally use less energy.	
Major Appliances 28. Refrigerator 29. Clothes Dryer 30. Age of Appliances	Refrigerators, which run all day every day of the year, can use about 25% of your electricity.	• **Open and close the refrigerator door quickly** and reduce the number of times you open it. • **Clean the coils of your refrigerator** and be sure there's room for air to circulate around the appliance. • **Dry full loads** of laundry. • **Set dryer to auto-dry** rather than a timed cycle.		• **Replace old appliances** with low energy-use appliances. Look for Energy-Star-rated appliances. Since 1980, appliances have improved in energy efficiency by 30 to 90%. Check with your utility company for rebates.
Tranportation 31. Carpool or Public Transportation	In California, close to 40% of the energy we use is for transportation.	• **Carpool** whenever possible. • **Walk or bicycle** when it is safe and possible.	• **Take public transportation.** • **Keep your car's engine tuned** and the tires properly inflated.	• **Buy a car that gets high gas mileage,** such as a hybrid that uses an electric motor along with the gasoline engine.

School Water & Energy Survey

Name:_____ Date:_____

Is your school efficient or extravagant in its use of water and energy? Complete this survey to find out. For some questions, you may need to talk with the school maintenance supervisor. ***Circle the answer that is most true for your school.***

PART 1: WATER

Indoors

1. Leaks. Do any indoor drinking fountains, faucets, pipes, or showerheads leak? Check in the classrooms, hallways, restrooms, gyms, and cafeteria.

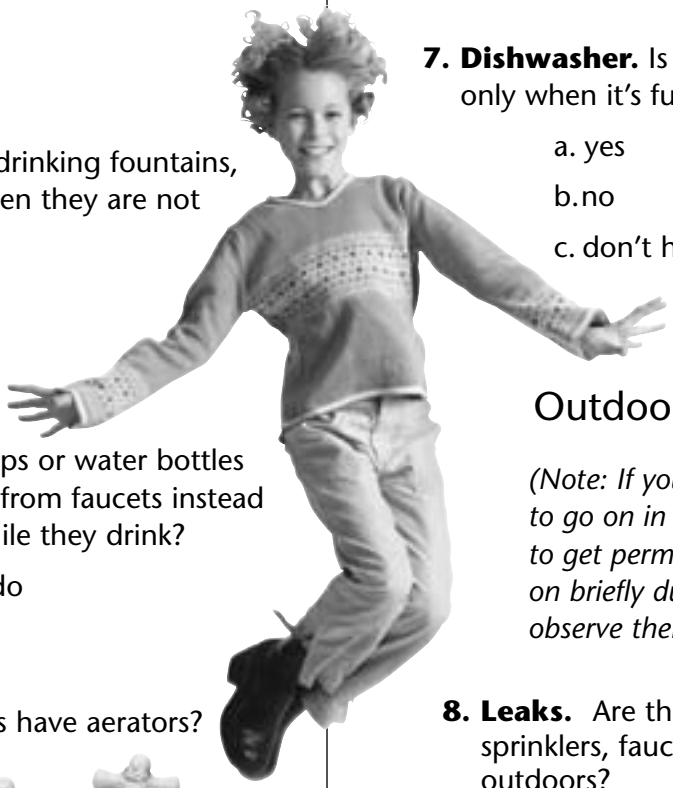
a. no

b. yes

2. Faucets. Are any faucets, drinking fountains, or showers left running when they are not being used?

a. no

b. yes



3. Drinking Fountains. Do students fill reusable cups or water bottles from drinking fountains or from faucets instead of letting the water run while they drink?

a. yes, most students do

b. no, most do not

4. Aerators. Do most faucets have aerators? *(Not sure? See page 2.)*

a. yes

b. no

5. Toilets. What type of toilets are installed in your school? *(Look under the tank lid or just behind the seat, or ask the school maintenance supervisor.)*

a. ultra-low flush or low flush

b. regular

c. don't know

6. Showerheads. Do the showers in the locker rooms have low-flow showerheads? *(Not sure? See page 2.)*

a. yes

b. no

c. don't have showers

7. Dishwasher. Is the automatic dishwasher run only when it's full?

a. yes

b. no

c. don't have a dishwasher

Outdoors

(Note: If your school's sprinklers are set to go on in the middle of the night, try to get permission to have them turned on briefly during the day so you can observe them.)

8. Leaks. Are there any leaks in hoses, pipes, sprinklers, faucets, or drinking fountains outdoors?

a. no

b. yes

9. Clean-ups. Is water from a hose used to clean walkways or paved areas?

a. no

b. yes

10. Pool Cover. Is a cover placed over the swimming pool at night and at other times when the pool is not being used?

a. yes

b. no

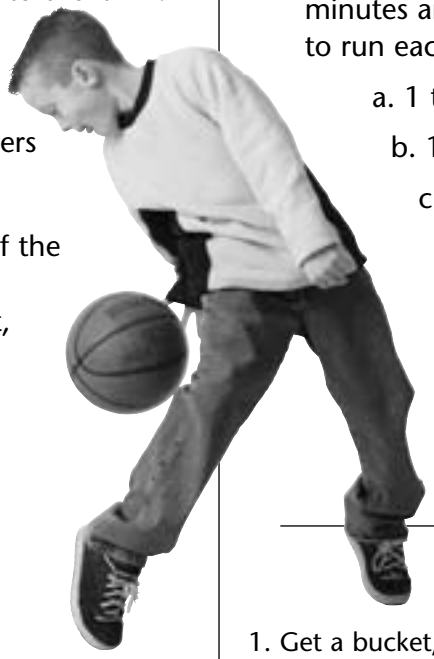
c. don't have a pool

11. Overspray. Are there any areas where the sprinklers spray more onto the pavement than onto the lawn?

a. no

b. yes

c. don't use sprinklers



12. Sprinkler Condition. Are any of the sprinklers not working properly; for example, is water gushing out, trickling out, spraying poorly or unevenly, or spraying in the wrong direction?

a. no

b. yes

c. don't use sprinklers

13. Seasonal Changes. Are sprinklers set to water less during cooler months and more during warmer months?

a. yes

b. no

c. don't have automatic sprinklers

14. Rain Shutoff. Does the sprinkler system have an automatic rain shutoff device that prevents the sprinklers from coming on during rainy weather or, if not, are sprinklers usually shut off manually in wet weather?

a. yes

b. no

c. don't have automatic sprinklers

15. Runoff. Does water run off the lawn either onto paved areas or down drains or gutters when the lawn is watered?

a. not very much

b. quite a lot

c. don't use sprinklers

16. Watering Amount. For approximately how many minutes are **most** of the sprinklers set to run each time they go on?

a. 1 to 10 minutes

b. 11 to 20 minutes

c. 21 to 30 minutes

d. more than 30 minutes

e. don't have automatic sprinkler system

Helpful Tips for Water Survey

Showerheads

Here's how to find out if you have low-flow showerheads. First get permission to do this test; then:

1. Get a bucket, a watch with a second hand, and a measuring cup.
2. Hold the bucket under the showerhead and have someone turn on the water at full pressure.
3. Let the water run into the bucket for 15 seconds.
4. Measure how much water is in the bucket and multiply the number of cups in the bucket by 4 (to figure how many cups per minute).
5. Convert the number of cups to gallons (16 cups in a gallon) to determine how many gallons per minute. If the amount is 2.5 gallons or less, the showerhead is a low-flow unit.

What's an Aerator?

Aerators mix air with water. If your faucets have little devices attached where the water comes out—devices with a little screen that makes the water bubbly—then they have aerators.

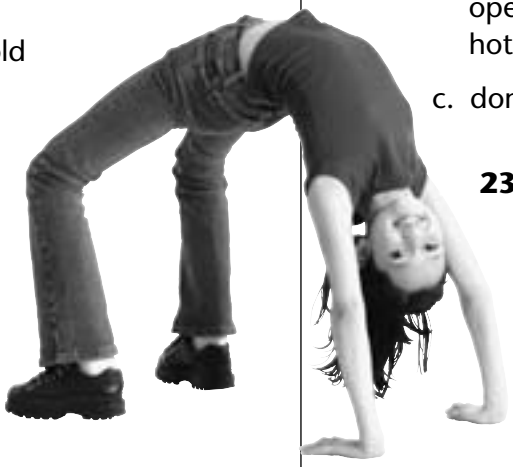
PART 2: ENERGY
Heating and Cooling

17. Heating System. How old is your school's heating system?

a. less than 10 years old

b. more than 10 years old

c. not sure



18. Heater Thermostat. At what temperature is the heat set when school is in session?

a. 68 degrees or lower

b. 69 degrees or higher

c. no thermostat

19. Air Conditioner Thermostat. At what temperature are air conditioning thermostats set when school is in session?

a. 78 degrees or higher

b. 77 degrees or lower

c. don't have an air conditioner or thermostat

20. Nighttime/Weekend Temperature. Is the heating/cooling system turned off or down at night and on weekends when the school is empty?

a. yes

b. no

c. don't have a heating/cooling system

21. Empty Rooms. Is the heating/cooling system turned off in rooms that are not being used for a day or more?

a. yes

b. no

c. don't have a heating/cooling system

22. Closing Windows and Doors. Are windows and outside doors kept closed when the heat or cooling is on?

a. yes, most of the time

b. no, sometimes accidentally left open or opened on purpose when the heat is too hot or the cooling too cold

c. don't have a heating/cooling system

23. Air Leaks. Does air leak in or out of windows and doors when they are closed? *(Not sure? See page 4 for the "draftometer" test.)*

a. no

b. yes

24. Blocked Vents. Are heating or air conditioning vents blocked by furniture or other obstructions, such as stacks of books, equipment, drapes, etc.?

a. no

b. yes

c. don't have vents

25. Shade Trees. Do trees shade the east and west sides of school buildings?

a. yes

b. no

Lights and Appliances

26. Lighting Unused Rooms. Do rooms that are not being used have the lights off?

a. yes, most of the time

b. no, lights often left on

27. Too Much Lighting. Are rooms or areas in the school receiving more light than is needed? *(To find out how to check, see below.)*

a. no

b. yes

28. Turning Things Off. Are lights and electrical equipment (e.g., computers, TVs, radios) turned off consistently when they're not needed for more than an hour?

a. yes

b. no

29. Fluorescent Lights. Is your school lit mostly by fluorescent or by incandescent light? *(Not sure? See below.)*

a. most lights are fluorescent

b. most lights are incandescent

30. Keeping Clean. Are light fixtures, skylights, and windows clean or dirty?

a. most are clean

b. most are dirty

Cafeteria

31. Ovens. Are the ovens turned off when nothing is cooking?

a. yes

b. no

c. don't have ovens

32. Exhaust Fans. Are exhaust fans (usually found above the stove or in the ceiling) run only when food is cooking?

a. yes

b. no

c. don't have exhaust fans

33. Refrigerator Coils. Are the refrigerator coils clean or dirty? *(Coils are usually located on the back of the refrigerator.)*

a. clean

b. dirty or dusty

c. don't have refrigerators

34. Equipment Placement. Are stoves or other heat-producing equipment located next to refrigerators or other cooling equipment?

a. no

b. yes

c. don't have stoves and/or refrigerators

Helpful Tips for Energy Survey

Draftometer Test

To check windows and doors for leaks, conduct the following "draftometer" test.

1. Cut a piece of thin, plastic food-wrap about 5 inches wide and 10 inches long.
2. Tape the short edge of the plastic along the edge of a pencil.
3. Hold the draftometer near the edges of doors and windows. If the plastic moves, then air is leaking in or out.

Too Much Light?

Try this to find out:

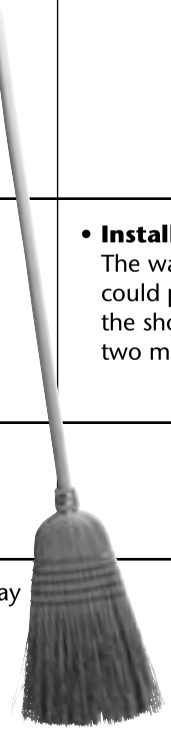
1. If a room is lit by several light fixtures, try leaving various switches off.
2. If that leaves entire areas too dark, talk to the maintenance staff about removing a fluorescent tube here and there to see if all the tubes are needed for enough light. (Be sure not to leave any sockets for incandescent bulbs empty, which poses a danger for shock.)

What's Fluorescent and What's Incandescent?

Fluorescent lights are usually either tubes or oddly shaped bulbs, both of which stay cool when they're on.

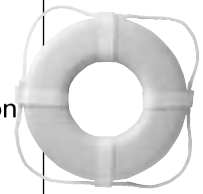
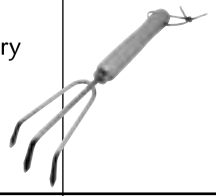
Incandescent lights are usually round bulbs that get very hot when they're on.

Ways to Save Water & Energy at School

Part 1: WATER		No Cost Ways	Low Cost Ways	More Cost Ways
Leaks 1. Leaks (indoors) 8. Leaks (outdoors)	A slow leak of only two tablespoons a minute wastes 15 gallons a day—that's more than 5,000 gallons a year! 		• **Fix the leaks.**	
Running Water 2. Faucets 3. Drinking Fountains 4. Aerators	About a gallon of water a minute flows out of a running faucet...and down the drain.	• **Turn the water off** if you see a faucet, drinking fountain, or shower left running when no one is using it.	• **Install aerators** on all your faucets; they are inexpensive and easy to attach.	
Toilets 5. Toilet Type	A regular toilet flushes away 5 to 7 gallons of water—a lot more than is needed. Low-flush toilets use only 3.5 gallons, and ultra-low flush use only 1.6 gallons to do the same job.			• **Install new toilets.** Check with your water agency for programs to help your school get new ultra-low flush toilets.
Showers 6. Showerheads	Low-flow showerheads can use up to 75% less water than regular ones—and still provide a good shower. Using less hot water means using less energy as well.		• **Install new showerheads.** The water and energy savings could pay back the cost of the showerheads in as little as two months. 	
Dishwasher 7. Dishwasher	The dishwasher uses 15 or more gallons of water each time it runs—empty or full.	• **Be sure it's full** before running the dishwasher (or a clothes washer).		
Cleaning 9. Clean-ups	A hose delivers about 10 gallons of water a minute (more for bigger hoses).	• **Use a broom** to sweep away dirt, leaves, and grass. 		

Ways to Save Water & Energy at School

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

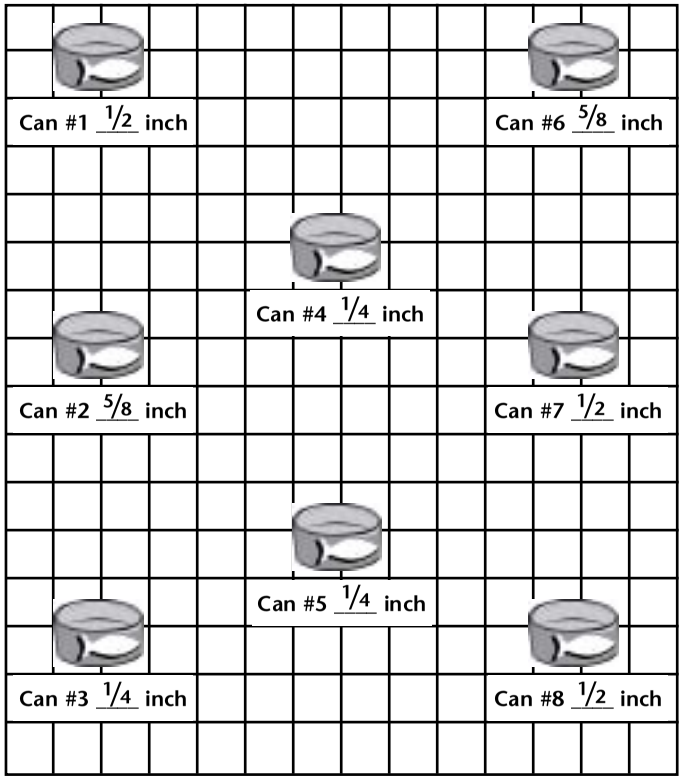
		No Cost Ways	Low Cost Ways	More Cost Ways
Pools **10. Pool Cover**	An uncovered pool loses from 900 to 3,000 gallons of water per month, depending on size, weather, and water temperature. A cover cuts down on evaporation and heat loss—saving water and reducing energy costs up to 90 percent.			• **Cover the pool at** night and when it is not being used.
Sprinklers **11. Overspray** **12. Sprinkler Condition**	A little overspray can't be helped, but you don't want more pavement than lawn being watered!	• **Adjust sprinklers** so that they spray onto the lawn. • **Clean out** clogged dirt and grass from sprinklerheads.	• **Fix or replace broken or missing sprinklerheads.**	• **Xeriscape.** Replace water-guzzling plants and lawns with low-water users.
Seasonal Watering **13. Seasonal Changes** **14. Rain Shutoff**	Lawns generally do not need as much water in the fall, winter, and spring as they do in the hot summer months. And they may need little water during the rainy season.	• **Change times with the seasons,** programming the water system to match the seasons and the weather. 	• **Install a rain shutoff device,** which automatically shuts off the sprinkling system when rainwater fills a collecting pan.	
Runoff **15. Runoff**	If water is running off the lawn, it may mean: 1. The soil is not absorbing the water. 2. The sprinklers are staying on too long.	• **Reduce the time** the lawn is being watered. • **Water more frequently for shorter periods,** especially if the lawn is sloped or if the soil contains clay.	• **Aerate the lawn** (poke holes into it) if the soil is very hard and compacted.	
Lawn Watering **16. Watering Amount**	Many lawns are watered more often than they need to be, or they might be watered for too many minutes at a time.	• **Do the sprinkler test** *(explained on the next page)* to determine how often and how long to water; then adjust your sprinkling times.		

Ways to Save Water & Energy at School

Sprinkler Test

1. Place 5 to 10 straight-sided cans of the same type (such as tuna cans or cat food cans) evenly around the lawn and mark their location on a map or grid ➔ of the lawn.
2. Run the sprinklers for 15 minutes.

3. Measure the depth of water in each can with a ruler and indicate on the grid the amount in each can.
4. Determine the average amount by adding up all the inches of water and dividing by the number of cans.
5. Multiply the average depth by 4 to determine how many inches of water your sprinkler system applies per hour.



Example

Total for 8 cans = 3¼ inches (3.25)

3.25 ÷ 8 = .406 inch/can

.406 x 4 = **1.624 (1⅝ inches) per hour**

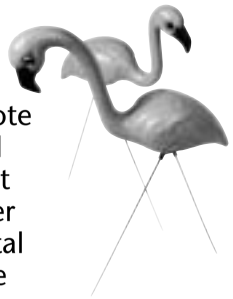
Analyze Your Results

First... Note any big differences in the amount of water in the cans.
If, for example, one can has ⅝ inch of water and another has only ¼ inch, it means that the sprinklers are not watering uniformly. Look for problems in the sprinklerheads, such as clogs or breaks. If part of the lawn isn't receiving enough water, brown spots can occur; if part of the lawn is receiving too much water, runoff can occur.

Second... Determine how many minutes you need to water your lawn each week.
Check the Lawn Watering Guide for California, ANR Publication 8044, on the ANR Communication Services website at http://anrcatalog.ucdavis.edu. The total number of minutes that your lawn should be watered each week will depend on:

- how much your sprinkler output is per hour (what you calculated from the Sprinkler Test)
- where you live in California
- what month it is
- what kind of grass you have.

Third... Adjust for your lawn.
Deeper, less frequent watering (sometimes only once a week) is best for most lawns to promote deep root growth. But a sloped lawn, hard or shallow soil, a hot climate, certain grasses, or other factors may require that the total number of watering minutes be spread throughout the week.

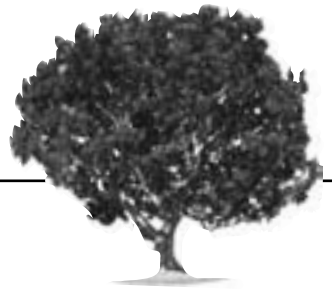


Ways to Save Water & Energy at School

Part 2: ENERGY		No Cost Ways	Low Cost Ways	More Cost Ways
Age 17. Heating System	Most new heating systems are about 30% more efficient than old ones, which means they are better for the environment and much less costly to operate.			• **Install a new heating system.**
Thermostats 18. Heater 19. Air Conditioner 20. Nighttime/ Weekend 21. Empty Rooms	Both heating and air conditioning consume enormous amounts of energy, most of it during peak mid-day hours when utility companies are running at full capacity.	• **Adjust the thermostats** to 68 degrees or lower for heat and 78 degrees or higher for air conditioning. • **Turn system off** at night and on weekends or at least set thermostats very low for heat and very high for air conditioning. • **Close vents** or turn off thermostats in rooms that are not being used—even if only for a day. • **Adjust windows and window coverings.** Instead of using the AC, open windows, when possible, to let in cool air; close window coverings to keep out hot sunshine. • **Monitor the system** to make sure no rooms are too hot or too cool.		
Windows & Doors 22. Closing Windows & Doors 23. Air Leaks	A heating or cooling system isn't very efficient if the warm or cool air is just allowed to escape through open windows or doors.	• **Close windows and doors** when the heat or air conditioning is on.	• **Caulk** around holes and cracks where air is leaking in or out, and weather strip around window frames and outside doors. 	
Vents 24. Blocked Vents	If anything is keeping the air from coming out of the vents, the heater or air conditioner is not working efficiently.	• **Remove any obstructions** so that there is clear space in front of vents.		

Ways to Save Water & Energy at School

CONSERVATION CONNECTION
WATER & ENERGY USE IN CALIFORNIA

		No Cost Ways	Low Cost Ways	More Cost Ways
Trees **25. Shade Trees**	Generally, during warm months, morning sun shines on the east side of buildings and afternoon sun beats down on the west side. Planting shade trees can significantly cool the inside of buildings.			• **Plant shade trees** on the east and west sides to shade windows—especially if you live in a warm climate.
Unnecessary Use **26. Lighting Unused Rooms** **27. Too Much Lighting** **28. Turning Things Off** **31. Ovens** **32. Exhaust Fans**	Just leaving lights on in empty rooms can waste thousands of dollars each year. 	• **Turn off switches,** where possible, in rooms that have multiple switches. • **Remove some bulbs** (fluorescents) to reduce excess lighting or leave in some burned out incandescent bulbs. • **Turn things off,** especially lights, when you're the last person leaving a room. Turn off appliances when no one is using them. • **Don't pre-heat the oven** and be sure it is turned off as soon as the food comes out. • **Turn exhaust fans off** when nothing is cooking.		• **Install motion sensors,** which automatically turn lights off when no motion is detected in a room, and then back on when someone enters the room.
Light Bulbs **29. Fluorescent Lights** **30. Keeping Clean**	Fluorescent lights use about 1/4 the energy of incandescent lighting.	• **Clean light fixtures, skylights, and windows.** More natural light will come in through clean windows and less energy will be used by clean light bulbs.	• **Use compact fluorescent bulbs** where possible, particularly in areas where the lights are left on for a long time. Compact fluorescent bulbs cost more to purchase, but they last 10 times longer and use much less electricity, so they save energy costs over their lifetime.	
Refrigerators **33. Refrigerator Coils** **34. Equipment Placement**	Coils remove heat from the inside of the refrigerator. If they are dirty, they won't work efficiently and the refrigerator will have to stay on longer. And if the refrigerator is next to a stove, it has to work even harder and run longer to keep cool.	• **Clean the refrigerator coils regularly.** • **Rearrange equipment** so that heat-producing appliances are not next to those keeping things cool.		

CORRELATIONS TO CALIFORNIA STATE CONTENT STAN-

	Science	Language Arts	Math
Grade 6			
Lesson 1	4a, 6b	R 1.1, 2.3	
2	7f	R 1.1, 2.3 LS 1.4, 1.5, 1.7, 2.2a	
3		R 1.1, 2.3	NS 2.3 S 2.1, 3.2 MR 2.5, 3.1
4	3d, 4a, 4b, 6a, 6b, 6c, 7c	R 1.1, 2.3 W 1.2a, 1.2b LS 1.4, 1.5, 1.6, 1.7, 2.2a,b	
5		R 1.1, 2.3	A 2.1, 2.2 S 2.1, 3.2 MR 2.5
6	3a, 3b, 3d, 7d		MR 1.1, 2.5
7	3a, 3b, 3d, 7d	W 2.5a,b,c LS 1.4, 1.5, 1.6, 1.7, 2.4a,b,c,d, 2.5a,b	MR 1.1
Grade 7			
Lesson 1		LS 2.2a,b,c	
2		LS 1.4, 1.5, 1.6, 2.2a,b,c	NS 1.3
3			NS 1.3, 1.6 A 1.1 MG 1.3 MR 2.6, 2.8
4	4e	R 1.2 W 2.3a,b, 2.5a,b,c LS 1.1, 1.4, 1.5, 1.6 2.2a,b,c, 2.3a,b	NS 1.3 A 1.5
5		LS 2.2a,b,c	MG 1.1, 1.3 MR 2.6, 2.8
6			MR 1.1, 2.6, 2.8
7		LS 1.4, 1.5, 1.6, 2.4a,b	MR 1.1
Grade 8			
Lesson 3			A 5.0, PS 1.0
4	6a, 7e	W 2.3a,b,c,d, 2.4c	
5	3b, 5a		A 5.0, PS 1.0
6		R 2.1	A 5.0
7		LS 1.3, 1.6, 2.4a,b,c,d	

RESOURCES

Following are a few sites to explore for more information and other links concerning water and energy supply, demand, and conservation.

Alliance to Save Energy
www.ase.org

California Department of Water Resources
www.dwr.water.ca.gov

California Energy Commission
www.energy.ca.gov
www.consumerenergycenter.org

California Urban Water Conservation Council
www.cuwcc.org

Energy Information Administration
www.eia.doe.gov

Flex Your Power
www.fypower.com

Renewable Energy Policy Project
www.solstice.crest.org

Rocky Mountain Institute
www.rmi.org

U.S. Bureau of Reclamation
www.waterwiser.org
www.watershare.usbr.gov

U.S. Environmental Protection Agency
www.energystar.gov

Water Education Foundation
www.watereducation.org